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ABSTRACT

To determine whether current automotive mechanic training programs provide adequate exposure to the knowledge and skills needed to properly service and repair motor vehicles, data were gathered on the tasks, service and repair establishments, job market, labor force, and training programs. Primary sources of data are reports prepared by various departments and offices of the government. These were supplemented by review of the literature and interviewing persons knowledgeable about service and repair of automobiles and training of auto mechanics. Findings indicate that: (1) Two thirds of the auto mechanics are employed by dealership garages, independent garages, and gasoline service stations, (2) Out-of-school youth constitute the primary source of entry-level automotive service and repair personnel, (3) Public high schools perform most of the automotive mechanic pre-employment vocational training, (4) The standard course guides developed by the AMA and the U.S. Office of Education have national applicability, are current, complete, and satisfactory, (5) A shortage of highly skilled, experienced mechanics exists, (6) More mechanics are trained annually than are absorbed by the industry, and (7) The present system of selection for participation in a high school pre-employment vocational training program is inappropriate and inefficient. (Author)

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A REVIEW OF THE LABOR MARKET, MANPOWER CHARACTERISTICS AND TRAINING OF MOTOR VEHICLE REPAIR PERSONNEL

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To determine whether current automotive mechanic training programs provide adequate exposure to the knowledge and skills needed to properly service and repair motor vehicles, data were gathered on the tasks, service and repair establishments, job market, labor force, and training programs. Primary sources of data are reports prepared by various departments and offices of the government. These were supplemented by review of the literature and interviewing persons knowledgeable about service and repair of automobiles and training of auto mechanics. Findings indicate that: 1) two thirds of the auto mechanics are employed by dealership garages, independent garages, and gasoline service stations, 2) out-of-school youth constitute the primary source of entry-level automotive service and repair personnel, 3) public high schools perform most of the automotive mechanic pre-employment vocational training, 4) the standard course guides developed by the AMA and the U.S. Office of Education have national applicability, are current, complete, and satisfactory, 5) course guides should be up-dated periodically, 6) a shortage of highly skilled, experienced mechanics exists; ~~demand for inexperienced graduates of high school automotive mechanic vocational training courses is relatively light~~, 7) more mechanics are trained annually than are absorbed by the industry, 8) the present system of selection for participation in a high school pre-employment vocational training program is inappropriate and inefficient. (Author)

TABLE OF CONTENTS

List of Figures

List of Tables

1. The Problem 1

2. Review of the Literature 3

    2.1. The Automobile 5

    2.2. The Work 6

    2.3. The Worker 10

3. Method 17

    3.1. Job Market 17

        3.1.1. Tasks 17

        3.1.2. Establishments 17

    3.2. Labor Force 18

    3.3. Interpretation 18

    3.4. Training System Selection 19

    3.5. Course Content 19

4. Findings: Tasks, Establishments, Labor Force, Job Market 21

    4.1. Repair, Maintenance, and Service Tasks . . 21

        4.1.1. Tasks Listed in the Dictionary of Occupational Titles 21

        4.1.2. Tasks Listed in Flat Rate Manual 21

        4.1.3. Tasks Listed in Manufacturers' Manuals . . . 27

        4.1.4. Tasks Listed in Other Studies 31

        4.1.5. Tasks That are Diminishing . 34

        4.1.6. Tasks That are Appearing . . 36

        4.1.7. Tasks That are Classified According to Vehicle Safety Standards 37

        4.1.8. Tasks not Otherwise Listed . 40

4.2. Repair, Maintenance and Service Establishments 40

4.3. Job Market 51

4.3.1. Working Conditions 51

4.3.2. Wages 58

4.3.3. Status 63

4.4. Labor Force 66

4.4.1. Tasks in Terms of Job Titles 66

4.4.2. Establishments in Terms of Job Titles 71

4.5. Labor Force Characteristics 75

4.5.1. Race, Sex, and Rural/ Urban Distribution 76

4.5.2. Geographic Mobility 77

4.5.3. Wages Earned and Hours Worked 79

4.5.4. Age of Workers 81

4.5.5. Marital Status 84

4.5.6. Educational Background . . . 84

4.5.7. Occupational Training 86

5. Findings: The Training Systems 90

5.1. The Non-System 90

5.2. The Institutionalized System 92

5.2.1. Public School Vocational Training Programs 93

5.2.2. Post-Secondary Vocational Training Programs 120

5.2.3. Adult Education Training Programs 124

5.2.4. MDTA Institutional Training 131

5.2.5. Commercial Trade School Training Programs 141

5.3. The Work-Oriented System 145

5.3.1. Apprenticeship Training Programs 145

5.3.2. MDTA On-the-Job Training Programs 154
5.3.3. Manufacturers' Training Programs 160
5.3.4. Armed Forces Auto Mechanic Training Programs 166
6. Analysis and Evaluation of the Findings 171
6.1. The Repair Problem and the Repair Tasks . 171
6.2. Repair Tasks and Establishments 172
6.3. Labor Force in Relation to Tasks and Establishments 179
6.4. Training Systems Versus Tasks, Establishments and Labor Force 182
6.5. Applicability of Standard Training Course Guides 186
7. Conclusions 188
8. Recommendations for Further Research 189
Appendix A: Median Age and School Completion 194
Appendix B: Cost of Automotive Mechanic Training Programs under the Manpower Development and Training Act 199
Appendix C: Unpublished Enrollment Statistics 204
References 209
Bibliography 216

LIST OF FIGURES

Figure Page

1. Distribution of all defects detected 41

2. Rank order of occupations according to percent of employees in a given age bracket 83

LIST OF TABLES

Table Page

1. Mechanic Tasks as Listed in a Flat Rate Manual 23
2. Transmissions and Associated Tasks 26
3. Manufacturers Manual Task Listing 28
4. Number of Repair Establishments Providing Given Repair Services 32
5. Frequency with Which Given Tools and Equipment are Found in Automotive Repair Shops 33
6. The Distribution of Repair Tasks Performed in Ann Arbor, Michigan 35
7. Survey of Items Inspected in 10 Jurisdictions Having Motor Vehicle Inspection 38
8. Repair, Maintenance, and Service Tasks that are Performed in Establishments Providing Full-Range Automotive Service 45
9. Distribution of Employees and Motor Vehicle Mechanics by Industry 46
10. Distribution of Service Work by Type of Outlet, 1955, 1960, 1961, 1963, and 1967 47
11. Comparison of the Number of Repair Establishments in Each of the Three Categories Providing Given Repair Services 48
12. Comparison of Number of Each Type of Auto Repair Shop Having Given Types of Service Equipment 49
13. Distribution of Establishments, Sales, and Employees According to Legal Form of Ownership 53
14. Legal Form of Ownership and Percent of Establishments, Sales, and Employees 54
15. Distribution of Establishments, Sales, and Employees According to Size of Establishment 55
16. Average Hourly Earnings for Selected Occupations in Metropolitan Areas for All Industries, by Region, 1967 . . 59
17. Average Hourly Earnings for Automobile Mechanics in Metropolitan Areas, by Industry Division and Region, 1967 59
18. Wage Rate by Employment Size 60

19. Wage Rate by Legal Form of Organization: Franchised Passenger Car Dealers 61
20. Occupational Ratings According to Norc and Duncan Scores 65
21. Automotive Service Occupations Listed in the Dictionary of Occupational Titles 68
22. Mechanic Classification Based on IGOA Mechanic Certification Program 69
23. Distribution of Mechanics Among Major Employer Groups . . 72
24. Number of Mechanics Required, 1969-1975 73
25. Employment Projections for 1975 for Automobile Mechanics and Repairmen by Industry 74
26. National Growth of Selected Items, 1962 to 1975 75
27. Characteristics of Selected Occupations by Race Sex, and Rural/Urban Distribution 76
28. Percentage Distribution of Male Experienced Labor Force, by Geographic Mobility, for Selected Occupations . 78
29. Percentage Distribution of Male Employed Labor Force, by Hours Worked per Week, for Selected Occupations . . . 80
30. Percentage Distribution and Median Age of Civilian by Age for Selected Occupations 82
31. Marital Status of Auto Mechanics, Other Skilled Occupations, and the Total Male Labor Force 85
32. Distribution of the Number of Years of School Completed 85
33. The Duration, Completion, and Use of Formal Occupational Training 86
34. Number of Training Programs and Institution Where Taken 88
35. How Training was Obtained and Most Helpful Way of Learning Current Job 89
36. Initial Training Source for Auto Mechanics (176 Survey Respondents) 91
37. All Ways of Learning Automotive Mechanic Occupation . . . 92
38. Most Helpful Ways of Learning Auto Mechanic's Trade . . . 93

39. Distribution of Occupational Training Programs According to Occupation and Level of Control 97

40. Enrollments and Expenditures for Auto Mechanic Training, Fiscal Year 1966 99

41. Placement of Automotive Mechanic Students Graduated From Public Schools in 1963, North Atlantic Region . . . 108

42. Subject Matter Divisions and Specific Item Under Each . 111

43. High School Vocational Automotive Mechanic Training Course Outlines; Subject Matter and Hours of Instruction 112

44. Course Content and Hours of Instruction for Sub-Entry Level, Entry Level, and Qualified Automotive Mechanics 116

45. Associate Degree Course in Automotive Technology (Lecture, Laboratory, and Related Instruction) 125

46. Occupationally Skilled Course for "Certified" Mechanic (Lecture, Laboratory and Related Instruction) 126

47. Entry Level Course for Automotive Service Mechanic (Lecture and Laboratory) 127

48. Per Pupil Cost, MDTA Institutional Auto Mechanic Program, Grand Rapids, Michigan, (20 Pupils, 40 Hours Per Week, 26 Weeks) 136

49. Distribution of Subject Matter and Classroom Hours in MDTA Institutional Auto Mechanic Training Courses . . 138

50. Criterion Course for MDTA Automotive Engine Overhaul Mechanic 140

51. Apprenticeship Earnings 149

52. Growth of Registered Apprenticeship Training 150

53. Content and Duration of Apprenticeship Auto Mechanic Work Experience Schedules 152

54. Chryslers Motors Corporation Automotive Technician Training Program Curriculum Schedule of Related Training Subjects 167

55. Examples of Manufacturers Short Training Courses 168

56. Repair Tasks and Repair Establishments 173

57. The Extent of All Purpose Capability in Relation to Establishment Type 180

58. The Range of Entry Level Skills Produced by the Various Training Systems 184

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1. THE PROBLEM

The intent of this study was to determine whether current automotive mechanic training practices provide adequate exposure to the essential knowledge and skills required to properly maintain and repair motor vehicles and to recommend satisfactory alternatives if these conditions are not being met.

There is a need to compare the tasks actually performed in the garage with the tasks being taught in the schools and garages. It should be determined whether the training realistically prepares a mechanic for his employment. Tasks which incidentally appear to be related to the national periodic motor vehicle inspection program and a proposed national safety standard for used cars will be included.

A number of different types of establishments provide repair services: manufacturers' agencies or dealers, independent garages, service stations, specialty shops, and others. A degree of selectivity was anticipated among the establishments in respect to kinds and amounts of various tasks performed in repairing and maintaining automobiles.

The labor force of the auto repair industry is expected to possess characteristics which may be described in socio-economic and psychometric terms of reference. Some degree of selectivity may be observed in the assignment of groups with similar characteristics to specific types of repair establishments.

Training systems or programs of instruction may demonstrate selectivity in the selection of repair and maintenance tasks in the curriculum, and consequently in the repair and service establishments. The selection of students for training to enter the labor force likewise may be selective.

Without these distinctions this study must progress on the assumption that all repair establishments respond to all repair and maintenances tasks, and consequently that all training courses will qualify all students to enter employment in every establishment.

The description of the job market, i.e., products or services to be performed, repair establishments, wages and working conditions, will depend upon data which has nation-wide applicability and which is provided by constituted data collecting agencies. Descriptions of the labor force will also be limited to similar types of available information.

The study assumes that a printed course outline is sufficient evidence of the skills and knowledge taught in the training system where the instruction is offered. The scope of this study prohibits the collecting and analysis of all course guides; therefore, only those materials attributed to a selected system will be utilized.

The purpose of the study is to determine the extent to which course guides in auto mechanics training do exist in order to determine suitability and, as necessary, to recommend the development of needed new materials or the revision or supplementation of existing materials.

The study is not intended to change or improve the job market, to motivate or affect the makeup of the labor force, or to evaluate and to judge the relative effectiveness of training systems except for purposes stated above.

2. REVIEW OF THE LITERATURE

Observers of the automotive industry in America have long been aware of a growing disparity between the size of the motor vehicle population and the size of the work force that maintains it. Although many periodical articles were reviewed, none stated the problem more clearly than the June 1968 issue of Motor, in which the editors point out that the situation has been steadily worsening for more than twenty years. The problem is stated in terms of the vehicle to mechanic ratio, which, according to current figures, is in the range of 130 vehicles per mechanic.

According to Automotive News [2], the present population of registered vehicles is about 100 million units. At the same time, the Bureau of Labor Statistics [3] reported that automotive service personnel and repairmen of all categories currently number about 1.5 million. Roughly half of these are classified as automotive mechanics; the remainder are service station attendants, parking lot attendants, lube men, car washers, and the like. This is the basis of the 130 to 1 ratio.

Lesh says [4] that there is no general agreement on the ideal vehicle-to-mechanic ratio. He attributes this to the relative emphasis given to factors such as the increased complexity of the automobile, improvement in tools and equipment, advances in diagnostic techniques, etc. Motor [1] reports that the ratio preferred by authorities in Detroit is 80 or 85 to 1, but that that figure is probably unrealistically low; a ratio of 100 to 1 is probably more reasonable.

Castor [5] indicated that the major complaints against the automotive service and repair industry include the high incidence of repair jobs that require refixing, the difficulty of getting work done, and the alleged high cost of maintenance and repairs. He points out that there is a cause and effect relationship between these difficulties and the size, as well as the quality, of the service and repair establishments. Paul E. McDonald, who is responsible for mechanic training at General Motors Corporation, stated [6] that although the industry is finding ways to cope with some of these problems, an important part of the solution will be to greatly increase the number of trained men entering the trade. Senator Philip Hart, conducting hearings on the cost of automobile repairs, is quoted in Automotive News [7] as suggesting that the industry and the government start a massive cooperative training program to keep up with the growing car population.

The emphasis in the periodical literature is clearly on the need for more and better trained auto mechanics. Lesh [4] points out that "the need does not appear to be for mechanics per se, but rather for 'good' or 'experienced' mechanics." This difference illustrates why it is so difficult to assess the needs of the industry in terms of mechanics. While the Dictionary of Occupational Titles [8] published by the U.S. Department of Labor includes a concise description of an automobile mechanic, there is little agreement in the field as to the requirements of the work, the qualifications of the workman, or the standards by which these things are classified. Employers seek a mechanic when they actually need a tune-up man, a brake man, or a squeak, rattle, and leak man.

The manpower requirements of the industry are affected by three sets of factors. The interrelationships of all three must be considered in securing and adequately training enough men to staff the industry properly. Both the problem and its solution are influenced by (1) automobile design and construction, (2) the nature and the place of the work, and (3) the characteristics of the worker. While these items cannot be easily separated in practice, they provide convenient headings under which to examine the background of the auto service and repair industry.

2.1. THE AUTOMOBILE

There has been a continuous effort to reduce the need for highly skilled mechanics [9]. This has been accomplished in many instances by improved design, although most of the changes in design or manufacturing technique are not for this purpose. In any case, the automobile had become a dependable and easily maintained machine prior to the outbreak of World War II. Although reliability and repairability were improving, the gains realized were being offset even then by the rapid growth of the vehicle population.

Garagemen, in trying to counteract an increasing shortage of skilled mechanics, found it expedient to use new or factory rebuilt parts in lieu of repairing or overhauling parts in their own shops. Snow [10] attributes this practice to economic circumstances in the automotive service and repair industry and concludes that it has led to a substantial reallocation of labor, i.e., one man on the assembly line has replaced several men doing the same thing in the garage. Mel Turner [11] pointed out that there has been a constant increase in the number of shops that specialize in the repair and overhaul of specific items of automotive equipment, thus concurring with Snow's analysis of the situation.

Manufacturing technique has also changed. In order to achieve production efficiency and cost advantages, many parts have been simplified and permanently assembled. Today it is often impossible, or impractical, to open up a unit and repair it. Switches, instruments, and solenoids, for example, are often permanently sealed; since faulty ones cannot be economically repaired, they are replaced.

Before World War II, the automobile was becoming progressively more durable, simpler, and, in many ways, easier to maintain. This led to predictions that the auto would soon become a maintenance-free machine. Coupled with the poor image of garage working conditions and low pay, this prediction tended to discourage many young men from pursuing a career in the automotive service and repair business.

Following World War II, automobile production multiplied rapidly, and the need for greater numbers of mechanics became increasingly apparent. The Independent Garage Owners of America pointed out in a 1968 mechanic recruitment pamphlet [12] that vehicle registrations rose from 32 million in 1940 to almost 73 million in 1960, an average increase of 2.1 million per year. Automotive News reported [13] that registrations had reached 100 million units in March 1969, and that the R.L. Polk company estimated the current growth rate at 3.1 percent per year. Thus the most important influence of the automobile itself on the problem of recruiting and training mechanics is probably the motor vehicle population growth rate, which continually increases the need for more manpower.

2.2. THE WORK

The review of the literature indicates that both the automotive service and repair work and the service and repair establishments are changing. Developments that grew out of the World War II technology, such as power steering, larger engines, and improved automatic transmissions, made the mechanic's job more difficult simply because these "improvements" filled up the space under the hood. Items which formerly were readily accessible and easy to change, such as spark plugs or fuel pumps, have become so embedded in the machine that often other parts must be removed just to gain access to them. The addition of emission controls will further aggravate the situation.

Likewise, the newer "space age" technology has two opposing effects. While it has contributed greatly to reliability, efficiency, and space-saving, such as with teflon seals, alternators, and micro-circuits, it has also complicated the repair process by introducing new materials, new concepts, new components, and additional items of equipment. The result has been to magnify deficiencies arising from the lack of understanding and the lack of competent personnel. Snow [10] concludes that the increasing sophistication and complexity of the automobile have been important factors in the industry's inability to cope with the increasing demand for quality service and repair.

In Safety for Motor Vehicles in Use [14] the Secretary of Transportation anticipates a work load increase in the auto service and repair industry, particularly in the event that Federal used car safety standards and universal periodic motor vehicle inspection (PMVI) are established. This study assumes that these circumstances will occur, and that the work load and work force of the future will necessarily have to accommodate these conditions.

A work force increase of about 11,375 mechanics would be required to handle the additional inspection work load. This estimate assumes that these inspections will be performed once a year in privately owned, state licensed garages in an average time of thirty minutes per vehicle [15]. Using registration figures published in Automotive News [9] there are:

32 states with PMVI	54,489,000 vehicles
7 states with random spot checks	28,118,000 vehicles
12 states no inspection required	17,351,000 vehicles

On this basis, 45,469,000 vehicles are not periodically inspected at this time (about 45.5 percent of the total).

According to O'Day and Creswell [16] increased inspection activity will not greatly increase the repair load in the long run. They conclude that inspections will mean that some classes of repairs, such as brake defects, will be made sooner, but, considering average car life, perhaps not a greater number of times. The wear-repair cycle will be moved ahead slightly in terms of car age, but, once the industry has caught up with the accumulation of negelected maintenance, the repair rate will stabilize at a slightly higher level than the present (ignoring the effects of population growth and increasing complexity of the vehicle).

The work load, however, will increase [14]. While 11,375 mechanics is a sizeable group of men, this may not be particularly significant in terms of specially trained manpower. Booz, Allen, and Hamilton conclude [17] that automotive mechanics do not require extensive training as motor vehicle inspectors in order to function properly in the inspector role. Thus, even if all 19 states that do not now require periodic vehicle inspection were to initiate inspection programs immediately, it is not likely that the industry would be unable to continue operating. Piore says [18] that personnel shortages are ordinarily overcome by the reassignment of existing manpower, thus unfilled job openings seldom result in a complete shutdown.

There are developments in the industry that, in terms of manpower allocation, may be as important as the increasing size of the work load. New concepts of business management and the specialization in specific aspects of automotive service and repair lead to a redistribution of the market and, consequently, to a reorganization of the industry.

The National Automobile Dealers Association shows [19] that dealership garages are decreasing in number and increasing in size and complexity. The function of these garages is becoming more and more to support the automobile merchandising system rather than to accomodate the motoring public at large. The importance of the service department to the new car sales effort makes it mandatory for the management to retain a staff of mechanics who are highly proficient with a given manufacturer's product, particularly the new models. In this case there is a need for product-oriented training, as well as for basic mechanic training.

The independent garages, as the name implies, have had only a tenuous relationship with the automobile manufacturers until very recently. Automotive News [20] reports that the independents are now actively seeking closer ties with the manufacturer, primarily because of their greater involvement with warranty work and their desire to obtain better parts discounts and availability. Leonard [21] indicated that the growth rate of independent garages is about six percent per year, which implies a continuing need to increase the output of the mechanic training establishment. The characteristics of this market, however, require the mechanic to have extensive knowledge of all makes and models of automobiles rather than a specialized knowledge of the products of one manufacturer.

Cecil [22] indicated that the gasoline service station operators are also becoming increasingly involved in automotive repair and warranty work. He sees a definite trend toward an increased complexity of the work done in the service station, and, consequently, a growing interest on the part of the service station operator in employing skilled mechanics. Many repairs are made in the service station, especially the replacement of parts with inexpensive help and with a high degree of customer satisfaction. But, as the repair activity moves toward more complex operations, the need for well trained and versatile mechanics increases.

Lesh [4] points out that another group of employers, the specialty shops, occupy a unique position in the industry. Because they specialize, they are able to employ inexpensive help. Since specializing is based on a systematic routine for replacing standard parts, low cost and customer satisfaction are more or less assured. Consequently, these establishments are absorbing more and more of the total repair load. While this implies an increasing need for mechanics, the nature of the work indicates that repairmen in this category do not need the extensive training to produce an all-around, competent mechanic.

The diagnostic center, a relatively new concept of the automotive service and repair business, is beginning to show up in significant numbers. Automotive Center Consultants, Inc. reported [23] that a Stanford University research study predicts 15,000 major diagnostic centers and perhaps 150,000 minor ones by 1975. This is interpreted to mean that 165,000 establishments, some new, will have adapted in some degree to the diagnostic center concept of automotive service and repair. The personnel required to staff such operations may not need skills that are significantly different from those used by mechanics in other kinds of general auto repair shops. Automotive Center Consultants, Inc. indicates that the technicians who operate these shops are, generally speaking, "good" mechanics who have been given additional training in the use of diagnostic equipment; the men who act as assistants and helpers are easily trained, since they do not ordinarily use the full array of skills required of the mechanic. But the men who perform the bulk of the repair work in these establishments are, in general, "average" mechanics.

Businesses and industries that maintain their own motor vehicles also employ a large number of mechanics. Since these men perform essentially the same range of tasks as the mechanics in the dealership garages, the independent garages, and the repair-oriented gasoline service stations, their technical training need not be significantly different from the others.

2.3. THE WORKER

Most employers agree [9] that formal pre-employment training is a highly desirable prerequisite for entry into the auto mechanics trade. Holtrop, Kurczynski, and Suda found [24], however, that comparatively few young men move directly into a mechanic's job upon graduation. Their data indicate that about 20 percent of the employed graduates classify themselves as mechanics or technicians; 41 percent of the graduates responded that the automotive courses were useful in connection with their work; 52 percent were found to be employed in the trade or in a related occupation.

Vocational and Technical Education, Annual Report, Fiscal Year, 1965, [25] published by the U.S. Department of Health, Education, and Welfare, shows that approximately half of the trade and industrial course graduates accept initial employment in the trade for which they were trained. While this includes all trades, it is assumed that a proportionate number of those who receive auto mechanic training also do not take up that occupation. Bedell shows [26] that only 40.5 percent of all auto mechanics and repairmen report having had pre-employment training for their occupation; i.e., many who enter the trade have not had the benefit of formal training.

The Advisory Council on Vocational Education reported [27] that about 33 percent of the graduates of trade and industrial courses are not available for placement in jobs due mostly to continuing education and to the draft. Wright states [28] that 16 percent of the enrollments in trade and industrial vocational courses are in automotive mechanics; his data show that there were 50,015 full-year and 4,544 half-year enrollments in automotive mechanics at that time.

Gil Putman makes the point [29] that out of 98,000 graduates of vocational school auto mechanic courses, only 17,000 entered the craft, indicating that a great many young men are interested in learning about the automobile, but that not very many of them care to become mechanics. Knoebel has found [30], however, that employers are seeking maturity beyond that of most high school graduates, and Lesh says [4] that, in spite of trade school graduation, most employers would not hire youth.

Levenson, Barnard, and McDill found [31] that pre-graduation, in-shop training (cooperative education) exerted a direct, favorable influence on post-graduation admittance to the trade. They conclude that auto shops do not compete with other kinds of businesses for the services of inexperienced youth, even though many of these young men have had two or three years of mechanic training, unless the specific shop has been directly involved in the growth and development of the specific youth.

While there are some questions concerning the use made of the output of current training programs, there is little doubt that the need for mechanics, hence the need for mechanic training, will increase. Lecht distinguishes between "crying need" and "firm demand" by estimating benchmark goals apart from aspiration goals [32]. He indicates that the anticipated normal growth will generate a firm demand for a 23 percent increase in the number of automobile mechanics and repairmen by 1975, or a benchmark population of 932,000 mechanics by that data. In contrast, the aspiration goal of 1,159,000 mechanics by 1975, representing a 53 percent increase in the mechanic population, can be characterized as a "crying need" for trained men.

In either case, the review of the literature suggests that there is an important connection between wages and the number of young men who pursue a course of instruction leading to employment in the industry. Snow concludes [10] that as long as garage owners continue to offer sub-standard wages to young automobile mechanics the annual output of school trained mechanics will be diverted to other industries, leaving the less capable to fill more of the job openings in the garages. Heummrich [33] has said that an increase in wages is probably the only realistic way to attract more better qualified men to the industry. Snow [10] points out, however, that no wage increase is likely without some force, such as a labor union, to exert pressure on the employer.

William Winpisinger, as quoted in Automotive News [34], told the Federal Trade Commission that auto mechanics are the lowest paid skilled tradesmen in the country, giving the national average wages of auto mechanics as $3.36 per hour, of factory machinists as $3.59 per hour, and of building trades journeymen as $5.09 per hour. He suggested that while greater union involvement might overcome the low mechanic wages the unions up to now have concentrated their attention of the factories, where the return on the organizing investment is more favorable.

In any event, it is a matter of continuing speculation whether or not the entry level pay is the primary determinant of the number and quality of young men entering the trade. While those authors reviewed, in general, recognize the influence of image, status, and working conditions, as well as pay, they also generally attribute the success or failure of the individual, the entrepreneur, and the industry to the quality of the workmanship; this, by implication, means the quality of the training. Thus, a review of the training establishment is entirely appropriate.

The U.S. Department of Labor [35] states that most automobile mechanics learn the trade through work experience. Starting as handy men or helpers, they generally spend three to four years acquiring the knowledge, the skills, and the tools to qualify as all-around mechanics. Although it is pointed out that most training authorities recommend a three or four year apprenticeship as the best way for a young man to learn the trade, an interview with Mr. Elliot French [36] revealed that there were approximately

6,500 auto mechanic apprentices registered as of February 1969. This indicates that the response to the apprenticeship program for auto mechanics has been something less than enthusiastic. Lesh [4] attributes the lack of appeal of the auto mechanic apprenticeship program to the sub-standard wage structure, particularly in the beginning stages, the futility of undergoing long and arduous training when good jobs in other occupations are readily available, and the fact that one can, with a little effort, become a first class auto mechanic, at top pay, without having to go through the apprenticeship routine.

According to Bedell [26] about 40 percent of auto mechanics have had formal job training; 48 percent had on-the-job training; and 61 percent had been involved in casual methods of learning. These percentages total more that 100 because some men indicated more than one way of learning the trade. About 14 percent said that formal job training was the most helpful; 28 percent felt that on-the-job learning was the best; and 40 percent thought casual learning was the best; note that only 1.6 percent favored apprenticeship training. Since Manpower Development and Training Act (MDTA) and Adult Education programs lean heavily on the principle of learning by doing, these figures may explain why these courses are generally well attended.

The U.S. Department of Health, Education, and Welfare [37] measures the success of the MDTA programs in terms of increased income for those who complete the courses, claiming that the improvement in income is significant. Main [38] states that MDTA training has only a slight effect on wage improvement since, in his study, as many non-trainees as trainees experienced a wage improvement during the period of the study. He concludes, however, that those who complete the training are more likely to be employed than those who do not receive training.

The major interest in the literature consistently revolves around the high school vocational training. Bedell shows [26] that about 41 percent of auto mechanic training was given in the high school, which constitutes the largest segment of all pre-employment training. Yet when an attempt is made to evaluate the effectiveness of the high school vocational programs, some difficulty arise.

Most of these evaluations are based on follow-up studies of the activities of the graduates. Since these are usually done by questionnaire, the respondents are ordinarily classified as (1) available for employment; (2) not available for employment; or (3) status unknown. While in some studies, the status unknown account for an inordinately high percentage of the graduates, the biggest difficulty arises in classifying the kind of employment. Sharp and Krasnegor point out [39] that a great deal of care must be used in interpreting the findings of these studies since there is no way to establish whether the job reported is in a training related occupation. In their words:

> The decision to classify a job as related or unrelated to training may be made on the basis of the individual's self-report or through a comparison of job titles and the particular program in which the graduate was enrolled. Obviously, there is considerable opportunity here for arbitrary decision making.

Kaufman et al. reported [40] that the major difficulties with the secondary school vocational programs lay not with the training programs themselves but in such matters as guidance and counseling, student placement, school-community relations, and the attitude of business, industry, and the unions toward the high school training programs. Their follow-up study of the graduates of area vocational, comprehensive, and academic education high schools revealed little difference in the influence of the school type on the suitability of youth for employment. Although the vocational school graduates were somewhat more readily accepted for initial employment, their earnings over a period of time were not as high as those of the academic high school graudates. Egermeier et al. [41] seem to confirm this. The first year follow-up study of those who completed their program indicates that vocational training seemed to enhance either stability of employment or securing of employment, but not the rate of pay; academic training appeared to be equally important as vocational training.

While there are at least three other important kinds of mechanic training institutions, post secondary schools, commercial trade schools, and the manufacturers' training organizations, they either do not figure prominantly in the literature, or their contribution is directed primarily toward the up-grading or up-dating of mechanics rather than toward pre-employment training. Consequently, these areas of interest will be discussed under the appropriate section of this report dealing with the findings.

3. METHOD

The study assumes that an examination of the industry and an analysis of the job market, manpower supply and the current training courses will permit a meaningful evaluation of the extent to which present training programs exist and the extent to which these contribute to satisfying the purpose of auto repair and service. Published data including statistical reports, on the auto repair and service job market and labor supply, will be collected and analyzed.

3.1. JOB MARKET

3.1.1. TASKS. Nationally acknowledge reference works and national reports by the industry will provide definitions of repair, maintenance and service tasks performed on automobiles.

The presentation of this material will follow the outline format and include the material found in Safety for Motor Vehicles in Use, by system, subsystem, or component. Criticality and probability categories will be noted.

Expert advice, through writings and interviews will be employed to assist in identifying repair tasks which show probability of being phased out. Emerging or changing tasks, including diagnosis and repair will be anticipated and recorded in the general context of repair, maintenance, and service.

3.1.2. ESTABLISHMENTS. Types of business establishments providing auto repair and service will be defined and described by means of objective published data. Expert advise and field observation will be employed to establish in general terms the correlation, if any, between tasks or groupings of tasks and repair establishments.

Other features of the job market will be reported. These include: employment prerequisites such as experience; education and training; earnings; advancement prospects; working conditions; and prestige status.

3.2. LABOR FORCE

Authoritive sources for estimates of the size of the current work force will be selected and reported. Assignment by types of establishment will be reported.

Estimates of current and projected shortages of auto repair and service personnel will be reported along with the basis for arriving at the estimate.

Information will be selected from published census and other data to determine and describe, in general, the socio-economic, psychological, and other characteristics of the current auto repair labor force. Expert advice, through writings and interviews, will be employed to determine the general correlation, if any, between classifications of employees and types of repair establishments.

3.3. INTERPRETATION

Findings on repair tasks, repair establishments, and repair personnel will be interpreted for the purpose of further delimiting the study. Tasks, establishments, employees or a combination of these which are determined to be of relatively small significance will be eliminated from further consideration.

The selected combination of tasks, establishment(s), and labor force will serve as the basis for an inventory and analysis of national training systems and training course content. To the extent that substantive data, expert opinion, and field observation permit nationally applicable conclusions, distinctions will be drawn between an expressed need and a market demand.

Manpower shortages will be presented as evidence and justification for job-entry-level training programs. Training objectives will be stated in terms of entry-level performance requirements. Anticipated entry-level earnings will be reported.

Availability of untrained manpower with necessary abilities and aptitudes to complete training and enter employment will be established in general terms. Data on working conditions, earnings, and status will be presented for other jobs requiring comparable skills.

3.4. TRAINING SYSTEM SELECTION

An inventory of all training systems will be constructed and data obtained from available published reports and records for each. The nature of the data will be consistent for all systems and will include: influence of particular tasks or cluster of tasks, influence of particular establishments, enrollment, job placement characteristics of trainees, facilities, staff, expenditures and other pertinent and comparable features. Evaluation will be objective and for the sole purpose of permitting comparison.

Expert advice will be employed to identify, for further study, the training system for which the greatest correlation exists with the selected segment or segments of the job market.

The study at this point is expected to depart, to the degree possible, from an extremely general hypothesis that any or all members of the labor force be trained through any or all training systems for employment by any or all establishments performing any or all repair and service functions.

3.5. COURSE CONTENT

Course outlines used by each training system will be collected. An analysis will be made using the selected system as a basis for comparison. In addition to a comparison among systems of units by content, hours assigned to classroom theory and total hours will be compared.

Units identified by analysis of course content of the selected training system will be correlated with those repair, maintenance and service tasks identified as most typical of tasks performed in a selected type of repair establishment.

Evidence will be sought, through expert opinion, writings, and interviews, of prerequisites for trainee selection, i.e., age, education, intelligence and aptitude. Likewise, achievement and attainment evaluation and measurement procedures will be identified and described. Standards for selection and attainment will be correlated in general terms with applicable characteristics noted in the labor force study.

4. FINDINGS: TASKS, ESTABLISHMENTS, LABOR FORCE AND JOB MARKET

4.1. REPAIR, MAINTENANCE AND SERVICE TASKS

This study assumes that an automotive service and repair facility can be described according to the kinds of repair, maintenance, and service tasks that are routinely conducted in that establishment, and that an auto mechanic training course can likewise be described according to the kinds of repair, maintenance, and service tasks that it presents to the student. The mechanic's work is the medium through which the industry and the training programs are compared. This section of the findings, therefore, is concerned with the tasks that are performed in the service and repair of automobiles.

4.1.1. TASKS LISTED IN THE DICTIONARY OF OCCUPATIONAL TITLES. The Dictionary of Occupational Titles [8] describes the mechanic's work in terms of operations such as removing and replacing units (engines, transmissions, differentials, etc.); disassembling and inspecting units for wear, damage, or malfunction; and repairing or replacing parts in accordance with manufacturers' specifications or manuals. Mechanics may overhaul or replace items such as carburetors, starters, generators, distributors, pumps, etc. and may install items such as radios, heaters, mirrors, tape players and windshield wipers. In addition to hand tools, the mechanic may operate lathes, shapers, drill presses, welders, lifts, hoists, and power hand tools such as pneumatic wrenches and electric drills. In other words, the mechanic may perform any task that is involved in the servicing, repair, or maintenance of a motor vehicle.

4.1.2. TASKS LISTED IN THE FLAT RATE MANUALS. The 1969 issue of Motor's Flat Rate and Parts Manual [42] was reviewed in order to identify further the repair, maintenance and service functions that constitute the technical work, or the tasks of the mechanic. Collision repair, or body work, is not included in this manual, and hence is not included in the list of tasks. In addition, the differences in engineering or manufacturing technique that distinguish one product from another, such as coil spring suspension vs. torsion bar suspension, have been disregarded. To eliminate duplication, only one product line was analyzed, but the complete range of tasks for that product is included.

The vehicle is broken down into 25 systems in the flat rate manual: maintenance, exhaust emission controls, tune-up and ignition, fuel system and intake manifold, exhaust system, starting motor, etc. Under each one of these labor operation titles, there is a labor operation index. The number of tasks under each index varies according to the complexity of the system. Table 1 shows the systems as they are listed under one make of automobile, and gives the index of labor operations under each system. The total number of tasks from this table is 261. A review of the complete listings in the flat rate manual indicates that the number of tasks per automobile does not vary substantially from one make of automobile to another.

The various types of transmissions are listed in separate chapters of the flat rate manual; thus transmission tasks are not included in Table 1. Table 2 lists the options that are available for the automobile shown in Table 1, and shows the number of labor operations that are indexed for each type of transmission. While this produces a total of 213 transmission tasks, this figure is misleading, since a high percentage of the tasks are identical within each category of transmissions. For example, there are two basic types of three-speed synchromesh transmissions. One series (three) lists 11 labor operations, and the other series (two) shows 10 operations. Thus, the table seems to indicate that there are 53 distinct tasks

TABLE 1. MECHANIC TASKS AS LISTED IN A FLAT RATE MANUAL [42]

Maintenance (A)
- Chassis lubrication
- Auto. trans. drain & refill
- Front wheel bearings repack
- Air cleaner, service or renew element
- Oil filter element, renew
- Rotate all wheels
- Fuel filter, renew

Exhaust Emission Controls (AB)
- Positive crankcase ventilator (PCV) valve, clean or renew
- Emission control, check
- Air pump, r&r
- Air pump, r&r and overhaul
- Air pump, tubes, renew
- Hoses, renew
- Relief valve, renew
- Check valve, renew
- Air bleed valve, renew
- Air pump belt, renew
- Air injection manifold ass'y., r&r or renew

Tune-up and Ignition (B)
- Tune-up minor
- Tune-up major
- Tune-up major & overhaul carburetor
- Plugs, points & condenser, renew or clean & adjust
- Spark plugs, clean and adjust or renew
- Compression, test
- Ignition timing, set
- Distributor, r&r or renew
- Distributor, overhaul (unit off)
- Distributor, adjust on stroboscope (unit off)
- Distributor cap, renew
- Ignition cable set, renew
- Vacuum control unit, renew
- Ignition coil, renew
- Starter and ignition switch, renew

Fuel System and Intake Manifold (C)
- Carburetor, r&r or renew
- Carburetor, r&r and overhaul
- Automatic choke thermostat, renew
- Automatic choke, overhaul
- Dashpot, renew
- Idle stop solenoid, renew
- Fuel pump, r&r or renew
- Fuel tank, r&r or renew
- Fuel system, clean
- Intake manifold gaskets, renew
- Manifold gaskets, renew

Exhaust System (D)
- Exhaust manifold, renew
- Heat control valve, renew
- Exhaust pipe, renew
- Muffler, renew
- Resonator, renew
- Tailpipe, renew
- Muffler and tailpipe, renew
- Exhaust system (except manifold), renew

Starting Motor (E)
- Starter, r&r or renew
- Starter, overhaul
- Starter drive, renew
- Brushes, renew & turn down commutator
- Starter solenoid, renew
- Starter solenoid, overhaul
- Starter and ignition switch, renew

Alternator (F)
- Alternator voltage regulator, adjust
- Alternator voltage regulator, renew
- Alternator, r&r or renew
- Alternator, r&r and overhaul
- Alternator stator, renew
- Alternator rotor, renew
- Alternator diodes, renew
- Alternator bearings, renew
- Alternator brushes, renew

Dash Gauges, Speedometer & Windshield Wiper (G)
- Fuel gauge (dash unit), renew
- Fuel tank gauge, renew
- Oil gauge (dash unit), renew
- Oil gauge sending unit, renew
- Temperature gauge(dash unit), renew
- Temperature sending unit, renew
- Ammeter, renew
- Speedometer head, r&r or renew
- Speedometer cable, renew or lubricate
- Speedometer cable and housing, renew
- Windshield wiper motor, renew
- Windshield wiper motor, overhaul
- Windshield wiper gear box, overhaul
- Windshield wiper Transmission Ass'y., renew
- Windshield wiper control, renew
- Instrument panel bulbs, renew

Battery Cables, Wiring Harness & Horns (H)
- Battery cables, renew
- Chassis wiring harness, renew
- Horns, renew
- Horn relay, renew

Lamps and Light Switches (J)
- Headlamps, aim
- Exterior bulbs or lens, renew
- Headlamp vacuum motor, renew
- Headlamp electric motor, renew
- Light switch, renew
- Headlamp foot switch, renew
- Stop light switch, renew
- Back-up light switch, renew
- Turn signal switch, renew
- Turn signal actuator, renew
- Turn signal and hazard flasher switch, renew

Cooling System (K)
- Radiator, r&r or renew
- Radiator hoses, renew
- Water pump, r&r or renew

TABLE 1. MECHANIC TASKS AS LISTED IN A FLAT RATE MANUAL (Continued)

- Fan belt, renew
- Clutch fan, renew
- Thermostat, renew
- Welch plugs (water jacket plugs), renew

Cylinder Head & Valves (L)

- Cylinder head, r&r
- Cylinder head, renew
- Cylinder head gasket, renew
- Valves, grind and tune-up (minor)
- Valves, grind (heads off)
- Cylinder heads, tighten
- One valve, renew and grind
- Rocker arm cover gasket, renew
- One valve spring, renew
- Valve stem seals, renew
- Rocker arm (one), renew
- Rocker arm stud (one), renew
- Push rod, renew
- Rocker arm and shaft ass'y., renew
- Rocker arm and shaft ass'y., disassemble & clean or overhaul
- Valve lifter (one), renew
- Valve lifters, r&r or renew all
- Valve lifter cover gaskets, renew
- Push rod cover gaskets, renew

Timing Case & Camshaft (M)

- Timing cover seal and gasket, renew
- Timing chain or sprocket, renew
- Camshaft, r&r or renew
- Camshaft bearings, renew
- Camshaft bearings, renew (engine out & disassembled)
- Camshaft rear welch plug (expansion plug), renew

Engine/Pistons, Rings, Bearings & Crankshaft (N)

- Rings, renew
- Rings, renew and grind valves
- Rod bearings (all), renew
- Main bearings, renew
- Main & rod bearings, renew
- Crankshaft, renew
- Rear main bearing oil seal (lower), renew
- Rear main bearing oil seal (upper and lower), renew
- Rings (one piston), renew
- Piston (one), renew
- Connecting rod (one), renew
- Rod bearing (one), renew
- Engine, r&r
- Engine, r&r and overhaul
- Engine, renew
- Cylinder block (fitted), renew and grind valves

Vibration Damper, Flywheel & Engine Mounts (O)

- Vibration damper, renew
- Flywheel r&r or renew
- Flywheel, renew (clutch out)
- Front engine mounts, renew
- Rear engine mounts, renew
- Front and rear engine mounts, renew

Engine Oiling (P)

- Oil pan, r&r and renew gasket
- Oil pump, r&r or renew
- Oil pump, r&r and overhaul

Clutch (R)

- Clutch pedal, adjust
- Clutch (or disc), renew
- Release bearing, renew
- Pilot bearing, renew (clutch out)
- Flywheel, renew (clutch out)

Rear Suspension (S)

- Shock absorbers, renew
- Spring, renew
- Upper control arm, renew
- Lower control arm, renew
- Track bar or bushings, renew

Universals and Rear Axle (T)

- Universal joints, r&r overhaul
- Propeller shaft center bearing, renew
- Propeller shaft alignment, check & adjust
- Axle and housing ass'y. (complete), renew
- Axle ass'y., r&r overhaul
- Cover gasket (or seal), renew
- Differential carrier ass'y., r&r or renew
- Differential carrier ass'y., overhaul
- Ring gear and pinion, renew
- Clutch plates, renew
- Differential side bearings, renew
- Pinion shaft bearings, renew
- Pinion shaft oil seal, renew
- Pinion drive flange (companion flange), renew
- Axle shaft, renew
- Axle shaft bearing, renew
- Axle shaft oil seals, renew

Brakes (U)

- Self-adjusters, disassemble & clean
- Brakes, adjust (major)
- Brake shoes or friction pads, renew and bleed system
- Parking brake, adjust
- Parking brake cables, renew
- Parking brake control, renew
- Master cylinder, r&r or renew
- Master cylinder, r&r and overhaul
- Wheel cylinders, renew
- Wheel cylinders, r&r and overhaul
- Caliper ass'y., r&r and overhaul
- Bleed system
- Flush and refill system
- Brake hose, renew
- Power brake unit, r&r or renew
- Power brake unit, overhaul
- Hub and drum (or disc), renew

Front Suspension (V)

- Toe-in, adjust
- Caster, camber & toe-in, adjust
- Steering knuckles, renew

TABLE 1. MECHANIC TASKS AS LISTED IN A FLAT RATE MANUAL (Continued)

Upper control arms, renew
Upper control arms, overhaul
Lower control arms, renew
Lower control arms, overhaul
Upper ball joints, renew
Lower ball joints, renew
Upper and lower ball joints, renew
Suspension, overhaul
Spring, renew
Lower control arm strut (or bushing), renew
Stabilizer shaft, renew
Stabilizer link (or bushings), renew
Shock absorbers, renew
Wheel bearings, renew
Front wheel oil seals, renew
Front crossmember, renew

Steering Linkage (W)
Tie rod ends, renew
Tie rods, renew
Intermediate rod, renew
Idler arm, renew

Manual Steering Gear (X)
Steering gear, adjust
Steering gear, r&r or renew
Steering gear, r&r and overhaul
Pitman shaft oil seal, renew
Steering column upper bearing, renew

Heater and Air Conditioning (Y)
Heater core, r&r or renew
Heater control ass'y., renew
Heater motor switch, renew
Heater blower motor, renew
Heater temperature control valve, renew
Air cond. control ass'y., renew
Air cond. blower switch, renew
Air cond. vacuum switch, renew
Air cond. blower motor, renew
Air cond. system, evacuate and charge
Compressor, r&r or renew
Compressor, overhaul
Compressor shaft seal ass'y., renew
Compressor clutch, renew
Receiver-dehydrator, renew
Liquid sight glass, renew
Condenser, renew
Expansion valve, renew
Evaporator, renew
Suction throttling valve, renew
Air Cond. hoses, renew
Vacuum diaphragm ass'y., renew

Locks, Striker Plates & Regulators (Z)
Front door lock, renew
Front door lock remote control, renew
Front door window regulator (or motor), renew
Front door ventilator regulator (or motor), renew
Rear door lock, renew
Rear door lock remote control, renew
Rear door window regulator (or motor), renew
Rear quarter window regulator (or motor), renew
Trunk lid lock, renew
Tail gate lock, renew
Tail gate window regulator (or motor), renew
Striker plates, adjust or renew

TABLE 2. TRANSMISSIONS AND ASSOCIATED TASKS [42]

Automatic Transmissions	Number of Tasks	Three-Speed Synchro-Mesh Transmissions	Number of Tasks
Type A	28	Type A	11
B	28	B	11
C	28	C	10
D	22	D	11
E	30	E	10

Four-Speed Synchro-Mesh Transmissions	Number of Tasks
Type A	7
B	7
C	7

for the three-speed synchro-mesh transmissions. However, 10 of the tasks are common to both series, while one series has one additional task; thus the total for the three-speed transmission is 11, not 53. The same difficulty arises in counting the tasks for the four-speed synchro-mesh and the automatic transmissions.

Power steering and glass replacement operations are also listed in separate chapters of the flat rate manual. There are 14 power steering labor operations listed for the particular automobile, which also are not included in the total from Table 1. The glass replacement labor operations are classified according to window location: windshield, front door window, rear door window, rear quarter window, and rear window. The various makes of automobiles are listed under these headings, and are broken down according to year, model and body style. Since this method of classification produces a very large number of virtually identical tasks this study assumes that, for a given window location, all glass replacement labor operations are the same.

Caution must be exercised in using the flat rate manual as a basis for task classification. The intention of the manual is to indicate the length of time and cost of parts required to accomplish a given repair; it does not indicate the complexity of the job, the level of skill required to do it, or the frequency with which the job occurs. For example, the book may allot 0.3 hour for a given repair on one model of a car, while it shows 5.5 hours for the same task on a different model of the same car. The difference is that on the second car it is necessary to remove and replace the engine in order to accomplish the same, identical repair. Thus, while the manual tells a great deal about the nature and the extent of the work, it does not tell what the mechanic does or how often he does it.

4.1.3. TASKS LISTED IN THE MANUFACTURERS" MANUALS. A more complete catalog of repair, maintenance, and service tasks is found in the manufacturers' overhaul or service manuals. While all manuals do not follow the same format, any of them can be considered typical in terms of the kind and extent of information listed. The information given here is derived from the service manual [43] for the automobile used in the analysis of the flat rate manual.

In this manufacturer's manual, 16 groups of components, systems, and service functions are listed. Table 3 represents this manual in outline form, showing the 16 groups, the sections that are listed under each group, and the number of tasks that apply to each section. Where alternate types of equipment are listed in a section, i.e., two windshield wipers, three heaters, etc., only one set of tasks is shown; this consolidates the information and eliminates multiple counting of tasks, without distorting the range of tasks the mechanic is expected to perform.

TABLE 3. MANUFACTURER'S MANUAL TASK LISTINGS [43]

COMPONENT OR SYSTEM	NUMBER OF TASKS
Group I	
General Information	None
Lubrication	23 to 25
Maintenance	25 to 30
Group II	
Windshield Wiper (Type A & B)	11
Heater System (Type A, B & C)	13
Heater-Air Condition System (Type A, B & C)	44
Group III	
Frame and Body Mountings (Type A, B & C)	2
Group IV	
Front Suspension (Type A & B)	24
Group V	
Rear Suspension (Type A, B & C)	11
Propeller Shaft (Type A & B)	7
Standard Differential (Type A & B)	22
Positive Traction Differential (Type A & B)	22 to 27
Group VI	
Manual Brakes (Type A & B)	33
Power Brakes (Type A, B & C)	33 to 49
Group VII	
Engine Mechanical (Type A, B & C)	54
Engine Fuel System - General	18
Fuel Pump	3
Carburetor (Type A, B, C & D)	14

TABLE 3. MANUFACTURER'S MANUAL TASK LISTINGS [43] (Continued)

COMPONENT OR SYSTEM	NUMBER OF TASKS
Group VII (cont.)	
Cruise Control	7
Exhaust Emission Control System	14
Generating System	20
Starting System	9
Ignition System	23
Group VIII	
Clutch (Type A, B & C)	12
Manual Transmission (Type A, B & C)	30
Shift Linkage	1
Automatic Transmission (Type A & B)	83
Group IX	
Fuel Tank and Fuel System	1
Exhaust System	4
Group X	
Manual Steering Gear	11
Power Steering Gear and Pump	39
Mast Jacket Assemblies	8
Tilt Wheel Mast Jacket Assemblies	8
Steering Linkages	1
Group XI	
Wheels, Tires, and Front End Alignment	31
Group XII	
Chassis Sheet Metal (Type A, B & C)	6

TABLE 3. MANUFACTURER'S MANUAL TASK LISTINGS [43] (Continued)

COMPONENT OR SYSTEM	NUMBER OF TASKS
Group XIII	
Battery and Cables	11
Lighting Systems	2
Signal Systems	9
Instrument Panel	10
Instrument Panel - Misc. Items	16
Radio	7
Group XIV	
Radiator and Grille (Type A, B & C)	2
Group XV	
Bumpers (Type A, B & C)	2
Group XVI	
Misc. Accessories (Intentionally Disregarded)*	

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*Tasks in this group are so numerous that only diagrams are shown and tasks not enumerated.

There are a total of 754 tasks listed in Table 3. While this indicates the number of jobs to which a mechanic might be assigned, it does not show the amount of work the mechanic does or the range of skills he needs. The text of the manual provides a step-by-step description of how each service or diagnostic function is to be done. Thus, although Table 3 does not show it, the mechanic may execute only one step in completing a task, or he may execute many steps and operations. The primary function of the manual is to assure that no step is overlooked, and that the steps are performed in the proper sequence.

This particular manual does not suggest an average time required to complete a task. It does provide, to some degree, a guide to the skill required to do the job, since it lists in detail the steps and operations that must be done. Like the flat rate manual, however, the service manual does not predict the frequency with which a given operation might occur (except for scheduled servicing such as chassis lubrication).

4.1.4. TASKS LISTED IN OTHER STUDIES. This study assumes that the frequency of a fault or malfunction influences the emphasis given to that item in the training program; the amount of training required to assure competence depends upon the capability of the trainee, the complexity of the job, and the frequency with which the job appears. Simple, routine tasks require very little formal training. Highly complicated tasks imply extensive training; but if the task occurs infrequently, or if the trainee is of doubtful ability, extensive training may not be warranted. Thus, the tasks that this study seeks to define are those that fall between these extremes.

In 1964, National Analyst, Inc. [44] published a study of automobile repairs made in gasoline service stations, dealership garages, and independent repair shops. They selected 18 components, systems, and maintenance operations which, in their view, constitute the core of the automotive service and repair work. They then counted the number of establishments that perform each of those kinds of work. The results give a picture of how extensively each category of work is performed, even though no frequency count of the specific task was made. Table 4 presents this information in a form slightly altered from the original. The number of establishments performing each category

TABLE 4. NUMBER OF REPAIR ESTABLISHMENTS PROVIDING GIVEN REPAIR SERVICES [44]

Repair Service	Number of Establishments
Lubrication and TBA	219,200
Engine Tune-Up	206,391
Exhaust System	192,550
Wheel Cylinders	181,301
Drive Train	164,603
Front End	163,590
Starter and Generator	154,799
Conventional Transmission	128,194
Power Brake Cylinders	120,224
Clutch	118,750
Steering Gears	116,309
Valves	104,521
Cooling System	94,695
Rebuild Engines	87,759
Water Pumps	85,595
Automatic Transmissions	84,518
Cores	57,256
Cylinder Reboring	39,775

of work has been totaled, and the tasks have been rearranged in the order of their frequency of occurrence.

Table 4 indicates, as might be expected, that the more complicated the task, the less frequently it is done. While a great deal of the work revolves around the simpler, routine service tasks such as lubrication and engine tune-up, the frequency of the task decreases as both complexity and skill requirement become greater.

The National Analyst study also compared certain types of service equipment found in these places of business. Nine items were selected from those data and are presented in Table 5 as further evidence of the kind and extent of tasks that are prevalent in the industry. As with Table 4, it is the tasks requiring the least complicated equipment and the lowest level of skill that are, in general, most common.

TABLE 5. FREQUENCY WITH WHICH GIVEN TOOLS AND EQUIPMENT ARE FOUND IN AUTOMOTIVE REPAIR SHOPS [44]

Kind of Tool	Number of Establishments
Impact Wrench	194,206
Wheel Balancer	165,720
Generator Tester	146,832
Engine Analyzer (meter or scope type)	120,404
Wheel Alignment Tools	67,823
Pin Fitting Equipment	63,151
Brake Shoe Grinder	52,745
Drum Brake Lathe	41,879
Cylinder Reboring Machine	32,044

The National Analyst study was concerned with the distribution of specific service and repair jobs as they occur in the three primary categories of repair agencies. In order to evaluate the distribution of the repair tasks themselves, a limited study was made of three garages in Ann Arbor, Michigan. Table 6 presents these data, which were derived from the work orders on file in each of the participating garages. Only one month's accumulation of work orders was used from each garage, although it is recognized that seasonal changes in weather affect the frequency of certain kinds of service and repair work. Radiator and cooling system repairs peak in mid-winter and mid-summer because of extreme temperatures; engine tune-up and carburetor adjustments peak in spring and fall because of changing temperatures. Thus, an accumulation of repair orders taken at a different time of the year would reveal a different emphasis of repair and service work, particularly in the section of the country in which this sample was taken.

The major interest here, however, is that the frequency of specific tasks is in general agreement with the distribution of these tasks throughout the industry. All of the establishments studied (Table 4) do general service and repair work, which is reflected in the equipment on hand (Table 5) and the accumulated work orders (Table 6). By the same token, relatively few places have engine overhaul equipment or do engine overhaul work.

4.1.5. TASKS THAT ARE DIMINISHING. An important aspect of the automotive service and repair industry is the rate and extent to which it is changing. The review of the literature indicated that manufacturing technology increasingly tends toward either factory overhaul or throw-away parts. In many cases, the cost of overhaul is higher than the cost of a replacement part; in some cases the unit is permanently assembled and cannot be disassembled without destroying it. Switches, instruments, solenoids, vacuum spark advance actuators, PCV valves,

TABLE 6. THE DISTRIBUTION OF REPAIR TASKS PERFORMED IN ANN ARBOR, MICHIGAN

Number of Repairs	Dealer I	Number of Repairs	Dealer II	Number of Repairs	Independent Garage I*
55	Lubrication, Oil Change, Oil Filter	25	Lubrication, Oil Change, Oil Filter	40	Radiator Repair
16	Winterize Cooling System	13	P.C.V. Valve Service	36	Lubrication, Oil Change, Filter
15	Service or Replace Air Cleaner	12	Adjust Carburetor	30	Major Tune-up
14	P.C.V. Valve Service	10	Major Tune-up	23	Replace Muffler and Tailpipe
14	Replace Fuel Filter	10	Replace Light Bulbs	16	Repair Heater
13	Minor Tune-up	8	Minor Tune-up	14	Repair Gas Tank
11	Major Tune-up	7	Repair and/or Replace Wiring	14	Service Battery
11	Analyze Engine	7	Adjust Brakes	12	Repair and/or Replace Water Pump
11	Balance Wheels	6	Balance Tires	11	Minor Tune-up
10	Replace Light Bulbs	6	Align Front End	9	Rust Proofing
8	Battery Service	5	Repair Tires	9	Repair and/or Replace Thermostat
7	Repair Heater	5	Repair and/or Replace Starter	9	Repair and/or Replace Starter
7	Replace Muffler and Tailpipe	4	Repair Gear Shift Linkage	9	Repair and/or Replace Clutch and Transmission
7	Repair Tires	3	Replace Fuel Filter	9	Repair Tires
6	Clean and Adjust Carburetor	3	Aim Headlights	8	Repair Carburetor and Choke
6	Align Front End	3	Windshield Washer and Wiper Repair	8	Replace Light Bulbs
5	Adjust Brakes	3	Overhaul Carburetor and Choke	7	Adjust Carburetor
5	Overhaul Carburetor and Choke	3	Replace Muffler and Tailpipe	7	Adjust Brakes
4	Repair Gas Tank	3	Overhaul Clutch and Transmission	6	Adjust Fan Belt
4	Aim Lights	3	Overhaul Brakes and Wheel Cylinders	6	Replace and/or Adjust Steering Linkage
4	Service Air Conditioning	2	Turn Brake Drums	6	Overhaul Brakes and Wheel Cylinders
4	Overhaul Clutch and Transmission	2	Repair and/or Replace Generator	5	Repair Distributor
4	Find and Repair Shorts in Wiring	2	Repair and/or Replace Thermostat	5	Overhaul Engine
3	Universal Joint Service and Repair	2	Repair Front Suspension	5	Grind Valves
3	Align Rear End	2	Repair Heater	5	Winterize Cooling System
3	Repair or Replace Timing Shaft	2	Adjust Fan Belt	4	Repair Carburetor Linkage
3	Windshield Washer and Wiper Repair	2	Repair and/or Replace Turn Signals	4	Repair Gear Shift Linkage
3	Replace Shock Absorbers	2	Repair and/or Replace Oil Pan	4	Repair and/or Replace Front Bearings and Seals
		2	Repair Speedometer	3	Repair and/or Replace Manifold
		2	Service Air Conditioning	3	Install Spark Plug Wires
		2	Repair Radio	3	Install Coil
				3	Replace and/or Repair Windshield Washer and Wiper

* This establishment specialized in cooling system repair and rust proofing: a service station was also attached.

light bulb receptacles, and many other parts cannot be economically repaired. Other parts, such as rubber-mounted suspension and steering linkage parts, no longer depend upon constant lubrication, and hence do not wear out as fast. The result is a greatly reduced frequency of replacement and a changing emphasis on the mechanic's work. Parts such as the DC generator and the electro-magnetic voltage controls are rapidly disappearing as the technology perfects and brings into production alternators, diodes and transistorized voltage control. Many of the traditional tasks of the mechanic fade away as new techniques appear.

4.1.6. TASKS THAT ARE APPEARING. Although new concepts of engineering and design are bringing about changes in the repair, maintenance and servicing of the automobile, these things have not, in general, changed the basic tasks that the mechanic is expected to perform. While the reliability of proven units tends to increase year after year, new developments force the mechanic to learn constantly. Most changes do not involve new mechanical principles, but simply produce new arrangements and combinations of component parts with which the mechanic has long been familiar.

The notable exception to this is in the field of electronics. Even in this area, however, the mechanic tends to gain more than he loses. The trend today is toward plug-in type circuit boards or micro-circuit components. Such devices give the mechanic a physically less confused configuration of wiring, more room in which to work, and fewer options as to repair procedure. They relieve him of the need to be an expert electrician, since there is little he can do other than plug in a new circuit.

Other aspects of advancement are also appearing. Disc brakes, brake proportioning valves, anti-skid devices, restraint systems (whether straps and inertia reel or air bag), energy absorbing steering columns and console-type cockpit layout all bring with them a requirement for a whole new body of knowledge. The important point is that the new knowledge does not depend upon understanding new scientific principles, but is simply a recataloging of the principles of physical laws (mechanics) that mechanics have always used.

One important aspect of new work that will have an impact on the mechanic's trade is federal legislation and control. This falls into two general categories: exhaust emission controls and vehicle safety items. The tasks involved in emission control, at this stage of development, are likely to rest primarily upon the engine tune-up man, who, for this reason, may become even more a specialist than he is today. Vehicle safety regulations, and such things as the safety defect recall campaign, may increase the emphasis on the mechanic's inspection capability, but it is unlikely that the vehicle safety requirements will substantially change the tasks the mechanic is performing today.

4.1.7. TASKS THAT ARE CLASSIFIED ACCORDING TO VEHICLE SAFETY STANDARDS. Another classification of maintenance, service and repair tasks relates the mechanic's work to the safety-related systems and components of the vehicle. A report compiled by the U.S. Department of Transportation [14] classifies automobile defects and malfunctions according to the probability of occurrence and the criticality of the malfunction should it occur. On this basis, the safety-related components and systems are listed according to the "safety priority level." This system allows the classification of every task according to its relative importance in maintaining the vehicle in a safe operating condition.

Table 7 lists the vehicle systems and the items in each system according to the safety priority level. While this does not indicate the frequency with which the related maintenance,

TABLE 7. SURVEY OF ITEMS INSPECTED IN 10 JURISDICTIONS HAVING MOTOR VEHICLE INSPECTION

Safety Priority Level A

- Steering:
  - Linkage
  - Wheel bearings
  - Drive belt
- Service brakes:
  - Master cylinder and reservoir
  - Wheel cylinder
  - Caliper assembly (disc brakes only)
- Tires
- Road illumination:
  - Headlight assembly

Safety Priority Level B

- Steering system:
  - Hydraulic booster
  - Grease seals
- Service brakes:
  - Shoes
  - Lines and fittings
- Suspension:
  - Attachment points
  - Linkage
  - Shocks and stabilizer links
- Power train:
  - Automatic transmission
  - Grease seals
- Windshield assembly:
  - Wiper-washer
- Road illumination:
  - Headlights
- Communication:
  - Turn signals
  - Brake lights
  - Brakelight switch
  - Running lights
- Hood:
  - Latch

Safety Priority Level C

- Steering system:
  - Wheel
  - Hydraulic pump
  - Steering knuckle
  - Spindle nut
  - Wheel studs
- Service brakes:
  - Pedal
  - Linkage
  - Drum
  - Pads (disc brakes)
- Parking brakes:
  - Lever
  - Linage
  - Shoes, etc. (drive shaft type)
- Wheel
- Suspension:
  - Springs
- Power train:
  - Engine
  - Wheel bearings
  - Studs
- Fuel subsystem:
  - Accelerator
- Exhaust subsystem
- Cooling subsystem:
  - Fan belt
- Bumpers
- Electrical subsystem:
  - Battery
  - Ignition
- Windshield assembly:
  - Glass
  - Windows, side
- Road illumination:
  - Headlight switch
  - Dimmer switch
- Main structure:
  - Body
  - Doors
  - Frame and panel
- Fenders

TABLE 7. SURVEY OF ITEMS INSPECTED IN 10 JURISDICTIONS HAVING MOTOR VEHICLE INSPECTION (Continued)

Safety Priority Level D

- Steering system:
  - Flexible coupling
  - Gearbox
- Service brakes:
  - Disc
- Tires:
  - Spare wheel and tire
- Power train:
  - Clutch
  - Universals
  - Differential
  - Case
- Fuel subsystem:
  - Carburetor
  - Fuel filter
  - Pump
  - Tank
  - Fuel pipe
  - Cap
  - Lines and fittings
- Exhaust subsystem:
  - Muffler
  - Tail pipe
- Cooling subsystem:
  - Radiator
  - Water pump
  - Hoses
- Electrical subsystem:
  - Starter
  - Fuses, wires, etc.
- Windshield assembly:
  - Defroster
- Windows, rear
  - Mirrors, side
- Road illumination:
  - Backup lights
  - Auxiliary lights
- Seats and headrests
- Seat belts and harnesses
- Instrumentation:
  - High-beam indicator
  - Turn signal indicators
- Heater

Safety Priority Level E

- Steering system:
  - Column
- Power train:
  - Gearbox
  - Propeller shafts
- Fuel sybsystem:
  - Intake manifold
- Exhaust subsystem:
  - Exhaust manifold
  - Emission control,
    - Positive crankcase
  - Headpipe
- Cooling subsystem:
  - Radiator cap
  - Thermostat
- Electrical subsystem:
  - Alternator/generator
  - Ignition switch
- Communication:
  - Horn
  - Reflex reflectors
  - Hazard flashers
- Main structure:
  - Frame
  - Body bolts
- Doors:
  - Hinges
  - Crash locks
  - Handles
- Hood:
  - Frame and panel
  - Hinges
  - Release
- Body:
  - Trunk
- Instrumentation:
  - Speedometer
  - Battery-charging indicator
  - Fuel gauge
  - Water temperature gauge
- Window-opening mechanism
- Air conditioner

repair and service tasks occur, it does indicate the importance to safety of these tasks and the emphasis that the associated system should receive in the training program.

A study conducted by the Highway Safety Research Institute, in which various vehicle safety inspection programs were investigated, gives some indication of the frequency with which safety-related maintenance tasks occur. McCutcheon and Sherman [45] found that, in general, the most frequently reported motor vehicle safety-related defects are associated with the more complex safety-related systems and components on the vehicle. Figure 1 shows the relative frequency of occurrence of the safety-related defects. While this does not show which tasks the mechanic is called upon most often to do, it does show how his time is distributed in correcting the safety-related defects.

4.1.8. TASKS NOT OTHERWISE LISTED. There are a number of tasks which, for one reason or another, are somewhat outside the mainstream of the activity of the general mechanic. While all of these are common to the service, maintenance, and repair of automobiles, they are increasingly moving away from the general shop and into the specialty house. Among these are tasks such as painting, body and sheet metal repair, frame straightening, upholstering, seat covers, convertible tops, radio, tape player and instrument repair, and glazing.

Another area in which there is increasing specialization is the field of component overhaul and rebuilding. Chief among these specialty houses are engine rebuilders, transmission rebuilders, and shops that renew items such as starters, generators, carburetors, fuel pumps, water pumps, etc. Other places specialize in activities such as crankshaft and camshaft grinding, cylinder reboring, valve grinding, etc.

4.2. REPAIR, MAINTENANCE AND SERVICE ESTABLISHMENTS

This study assumes that all categories of automotive repair

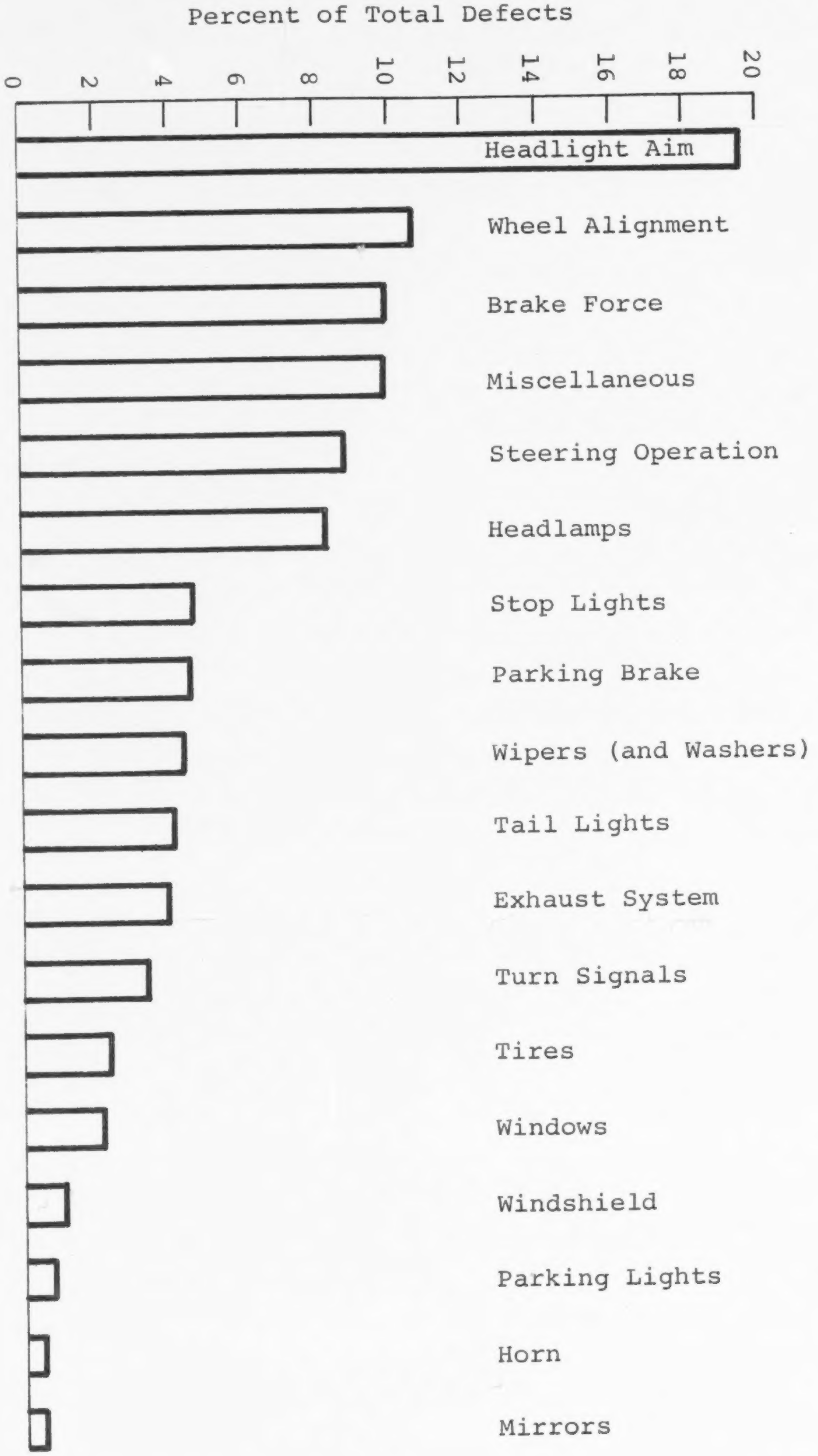

Figure 1. Distribution of all defects detected [45].

maintenance and service establishments employ men who are classified as automotive mechanics. It further assumes that all such establishments can themselves be classified as follows: (1) dealership garages; (2) independent garages; (3) gasoline service stations; (4) fleet operators; (5) specialty shops; (6) high volume shops; (7) diagnostic centers; and (8) spare time operators.

These designations categorize the various establishments in terms of the kind of business in which they are engaged, rather than in terms of the tasks performed by the mechanic. These businesses are described briefly in the following paragraphs.

Dealership Garages are repair and service facilities that are operated in conjunction with an automobile sales franchise. While the corporate structure of the dealership may indicate that the service department or garage is a separate corporate entity, the facility is intended to service and/or repair vehicles of a particular make; specifically the vehicles purchased from the dealership with which the garage is associated. They offer the full range of automotive service and repair.

Independent Garages are establishments that perform general maintenance and repair work for the motoring public at large; they are not representatives of an automobile manufacturer. A distinction must be made between independent shops that limit their work to a specific kind of repair or service and those that offer the complete range of normal service and repair.

Gasoline Service Stations are businesses that specialize in dispensing gasoline, lubricating oil, and minor routine maintenance service to the motoring public at large. These units are, in general, franchised dealers for a specific brand of gasoline and motor oils. A great many of these facilities offer a wide range of the more complex maintenance and repair work. Consequently, they must be considered one of the major types of automotive service and repair establishments.

Fleet Operators are companies, businesses, or industries that operate and maintain their own motor vehicles. They include trucking companies, taxi operators, bus companies, rental car agencies, sales agencies, government car pools, and others. While such fleets require the full range of service and repair work, they do not absorb a major portion of the available automotive mechanics.

Specialty Shops are establishments that limit their business to one or more component parts of the automobile, or to one or more specific maintenance and/or repair services. Thus they do not encompass the full range of mechanic tasks. These businesses may be part of a chain operation such as Midas Muffler or AAMCO Transmission, but many of them are independently owned small shops that provide a specialized service to the industry on a local basis. Their activities include things such as radiator repair, tire retreading, front end alignment, starter and generator work, upholstering, painting, body work, etc. The larger concerns, such as those that specialize in rebuilding engines, starters, generators, fuel pumps, carburetors, etc., are becoming an increasingly important influence in the distribution of the repair work as well as the character of the work performed by the general mechanic.

High Volume Shops operate as a service outlet for mass merchandising organizations such as Sears-Roebuck, Montgomery Ward, K-Mart, Korvette, Goodyear, Western Auto, and other concerns that retail large quantities of auto parts and services to the public at reduced prices. While these shops cover the complete spectrum of repair work, they tend to concentrate on the simple, straightforward jobs that produce high income per shop hour. Thus they tend to skim off the easily done jobs, leaving the more difficult, more costly, and less profitable work for the regular garages.

Diagnostic Centers do not as yet constitute an important segment of the automotive service and repair picture. They are, however, indicative of the direction in which analysis and replacement techniques are likely to develop. While they do not account for all kinds of service, maintenance, and repair, the diagnostic centers will exert stronger pressures on shop practices as they become more prevalent, consequently influencing training emphasis as well as repair methodology.

Spare Time Operators are of two kinds: those who are engaged in automotive repair for profit during off-duty hours away from their regular job and those who do repair, maintenance or service work on their personal cars during spare time. Although this activity is commonplace, according to Lesh [4], it is difficult to obtain an accurate estimate of its extent. George Fry and Associates found [46] that on a cumulative basis 40 percent of all motorists have at some time replaced or repaired parts on their automobiles. Their data indicate that while do-it-yourself mechanics perform about 30 percent of all simple maintenance, the proportion drops off rapidly as the tasks become more complicated. For example, five percent or less of piston ring or engine bearing replacements are executed by these mechanics. Likewise, those who are spare time mechanics for profit undertake the full range of mechanic tasks, but, according to Fry [46], they account for less than two percent of each of the numerous automotive repair, maintenance, or service tasks performed by the industry.

In terms of tasks performed, it is apparent that not all of the establishments listed above require the services of mechanics who are fully qualified in every aspect of automotive maintenance, service and repair. Since a primary objective of this study is to evaluate how the requirements of the industry as a whole fit the product of the training program as a whole, those establishments whose personnel do not require full-range mechanic training should be identified so that they may be eliminated from further consideration. The tasks listed by National Analysts [44] will be used as the criteria of eligibility; they are restated in Table 8.

TABLE 8. REPAIR, MAINTENANCE, AND SERVICE TASKS THAT ARE PERFORMED IN ESTABLISHMENTS PROVIDING FULL-RANGE AUTOMOTIVE SERVICE [44]

- Starter and generator
- Exhaust system
- Lubrication and TBA
- Steering gears
- Engine tune-up
- Power brake cylinders
- Wheel cylinder
- Front end
- Drive train
- Clutch
- Conventional transmission
- Automatic transmission
- Valves
- Cylinder reboring
- Rebuild engines
- Cooling system
- Cores
- Water pumps

Table 9 lists employer groups that are identified by the Bureau of the Census and the Bureau of the Census and the Bureau of Labor Statistics as employers of automotive mechanics. The table shows the number of each kind of employer, the total number of workers employed by each, and the number of automotive mechanics working for each [47-50]. This table will assist in determining which of the employer groups will be singled out for further study.

The total number of dealerships has been steadily declining from a peak of 49,173 in 1949 to 27,149 as of October 1969 [51]. There is no indication, however, that the dealership garages employ fewer mechanics. Leonard [21] shows that the dealership portion of the automotive service and repair market has decreased

TABLE 9. DISTRIBUTION OF EMPLOYEES AND MOTOR VEHICLE MECHANICS BY INDUSTRY

Industry	S.I.C. Code	A [48]			B [50]		C [47]			D [49]			
		Units	Employees	Estimated Number of Mechanics	Employees	Estimated Number of Mechanics	Units	Employees	Estimated Number of Mechanics	Employees	% of Mechanics That Are Employed In	Estimated Number of Mechanics	% of Employees That Are Mechanics
Automotive Dealer & Service Stations	55	218,076	1,469,731	284,687	1,470,000	284,739	98,514[b]	871,525[b]	238,014[b]	1,548,000	44.17	299,848	19.37
New & Used Car Dealers	551	31,649	667,681	182,344[b]	691,300	253,874[b]	33,349	630,817		883,000[b]	35.53[b]	241,147[b]	27.31[b]
Used Car Dealers	552	11,393	43,081		45,000		27,984	72,857					
Tire, Battery & Accessory Dealers	553	18,815	132,175		193,300[c]		25,899	131,081					
Gasoline Service Stations	554	147,969	584,857	51,643	538,900	47,588	211,473	732,542	64,683	665,000	8.64	58,719	8.83
Miscellaneous Automotive Dealers	559	7,919	40,069				11,282	36,710					
Automobile Repair, Services & Garages	75	67,218	339,549	188,347	334,500	185,547	139,611	425,340	235,936	404,000	33.01	224,099	55.47
Automobile Rentals (without drivers)	751	4,443	45,506		40,500		7,351	37,072					
Automobile Parking	752	4,287	37,256		36,400		11,269	41,482					
Automobile Repair Shops	753	52,599	188,678		257,600[a]		114,459	304,760					
Top & Body Repair Shops	7531	10,149	39,221				16,207	49,217					
Battery & Ignition Repair Shops	7532	1,280	4,305				2,066	6,226					
Radiator Repair Shops	7533	1,793	4,860				3,976	9,392					
Tire Retreading & Repair Shops	7534	2,647	16,381				4,071	19,826					
Paint Shops	7535	2,842	11,953				5,294	20,232					
Glass Replacement & Repair Shops	7536	1,042	4,604				1,542	5,675					
General Automobile Repair Shops	7538	27,044	84,154				72,416	162,711					
Automobile Repair Shops, N.E.C.	7539	5,778	23,141				8,887	27,844					
Automobile Services (except repair)	754	5,857	67,741				6,532	42,026					
Transportation Equipment Manufacture	37	7,221	1,953,384	33,012	1,911,500	32,304	7,196[d]	1,604,327[d]	27,113	1,684,000	4.19	28,460	1.69
Transportation	40-47	106,229	1,950,080	35,296						2,776,000	7.41	50,245	1.81

[a] Includes employees in S.I.C. 754

[b] Includes all of 55, except 554

[c] Includes employees in S.I.C. 559

[d] From U.S. Department of Commerce, Bureau of Census, Census of Manufacturing 1963, U.S.G.P.O., Washington, D.C.

from 40 percent in 1955 to 32 percent in 1967 (Table 10). However, car dealers went from 4.8 billion in 1958 to 7.2 billion in 1967, and employment in the dealerships rose from 594,000 in 1958 to 708,000 in 1967, or an increase in the average number of employees per dealer from 16 to 23 [19].

TABLE 10. DISTRIBUTION OF SERVICE WORK BY TYPE OF OUTLET: 1955, 1960, 1961, 1963 and 1967 (in percents) [21]

Outlet Type	1955	1960	1961	1963	1966	1967
New Car and Truck Dealers	41	38	32	34	33	32
Auto Repair Shops	17	20	21	20	19	19
Gasoline Stations	16	17	16	13	15	16
Tire, Battery, and Accessory Dealers	15	14	14	12	15	15
All Others	11	11	17	21	18	18
All Outlets	100	100	100	100	100	100

The independent garages, on the other hand, have been increasing in number; Leonard shows that their average annual growth rate is six percent. Table 10 indicates that the independent garages have increased their share of the service market from 17 percent in 1955 to 19 percent in 1967. While gasoline service stations are also steadily increasing in number at the rate of about six percent per year, Table 10 does not indicate that they are increasing their proportionate share of the market. In both cases, however, the annual growth rate is interpreted to indicate a growing volume of repair work, and hence a growing need for mechanics.

National Analyst, Inc. [44] found that repairs performed in the service stations are complex enough that at least one fully competent mechanic is needed at each station engaged in this work. Table 11 shows the range of repair work that the service stations perform, and also shows that they are perform-

TABLE 11. COMPARISON OF THE NUMBER OF REPAIR ESTABLISHMENTS IN EACH OF THE THREE CATEGORIES PROVIDING GIVEN REPAIR SERVICES [44]

Repair Service	Service Station	Car Dealer	Independent Repair Shop
Starter and Generator	53,669	37,784	63,346
Exhaust System*	86,647	35,471	70,432
Lubrication and TBA	158,852	25,446	34,902
Steering Gears*	20,630	37,398	58,281
Engine Tune-Up	94,899	38,169	73,323
Power Brake Cylinders*	41,260	31,615	47,349
Wheel Cylinders*	80,458	33,928	66,987
Front End*	86,647	35,856	41,087
Drive Train	53,639	38,169	72,795
Clutch	33,008	34,314	51,428
Conventional Transmission	28,882	37,398	61,914
Automatic Transmission	14,441	35,471	34,006
Valves	30,945	30,073	43,503
Cylinder Reboring	6,189	14,651	18,935
Rebuild Engines	18,567	28,916	40,276
Cooling System	39,197	24,290	31,208
Cores	16,504	12,338	28,414
Water Pumps	33,008	21,205	31,382

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*Safety related items (asterisks added by HSRI)

ing more of certain safety-related service and repairs than are either the independent garages or the dealerships. Repairs that involve safety-related items (according to Highway Safety Research Institute) are indicated on the table by asterisks; these items include the exhaust system, steering gear, power brake cylinders, wheel cylinders and front end.

Additional evidence of task similarity is found in the comparison of the automobile servicing equipment used in the service station, the dealership, and the independent garage. Table 12 lists 17 kinds of automotive service equipment and shows how

TABLE 12. COMPARISON OF NUMBER OF EACH TYPE OF AUTO REPAIR SHOP HAVING GIVEN TYPES OF SERVICE EQUIPMENT [44]

Equipment	Service Station	Auto Dealer	Independent Repair Shop
Air Compressor	187,735	38,169	95,169
Floor Jack	169,168	38,169	95,244
Battery Charger	177,420	37,784	84,805
Spark Plug Tester	127,907	37,013	52,352
Impact Wrench	88,710	34,700	70,796
Portable Lifts	94,899	31,250	48,826
Wheel Balancers	94,899	34,700	36,121
Four-Wheel Post Lift	96,962	30,073	25,122
Generator Tester	55,702	36,627	54,503
Engine Analyzer of Meter or Scope Type	41,260	36,627	42,571
Wheel Alignment Tools	18,567	18,892	30,364
Wreckers	18,567	18,892	30,364
Pin Fitting Equipment	10,315	26,603	26,233
Brake Shoe Grinder	14,441	18,892	19,412
Drum Brake Lathe	8,252	17,735	15,892
Frame Alignment Rack	16,504	14,651	10,259
Cylinder Reboring Machine	6,189	11,566	14,339

many establishments of each type use the equipment. While the equipment used for routine maintenance and servicing is commonplace across the board, equipment needed for complex tasks is found most often in the dealership or the repair shop rather than in the service station.

These data support Cecil's contention that there is a definite trend toward increased complexity in the repairs done at service stations and that these establishments are actively seeking well-trained mechanics [22]. The data also support Turner's feeling that the increase in jobber outlets reflects a decrease of engine, transmission, and component overhaul in the garages [11]. In other words, the organizations (jobbers) that wholesale new or rebuilt products to the retailer (garage) are supplying more and more of the overhaul labor, and the garages are performing less and less of it. This is confirmed by the small number of establishments performing overhaul operations and, likewise, by the number of shops using overhaul equipment.

One other commitment of the automotive service and repair industry must be considered: periodic motor vehicle inspection (PMVI). While 32 states either practice PMVI or have passed legislation that will soon require it, about 45 percent of the vehicles registered in the United States are not subject to PMVI as of this date. Some provision ultimately must be made to accommodate an additional 45 million vehicles in the inspection process [13]. If this work load is to be absorbed by the existing industry, some change in its structure is inevitable.

According to Snow [10], a change in the general practice of one segment of the industry simply shifts some of the burden to another part of the industry. In this case the non-inspection places, such as specialty shops and parts rebuilders which cannot perform vehicle inspections, will absorb a greater proportion of normal maintenance and repair work. This will make it possible for establishments with inspection capability, such as gasoline service stations, dealership garages, and independent repair shops, to allocate both space and personnel to the inspection process.

Booz, Allen, and Hamilton [17] found that vehicle inspection is not a critical problem in the training of automotive mechanics. Thus, there seems to be little need to consider the inspection function as a discrete mechanic task. While the work load generated by nationwide PMVI may require an additional 11,375 mechanics [15], this fact does not imply extensive changes in the mechanic training process. Consequently, the inspection function will be eliminated from further consideration in this study.

4.3. JOB MARKET

The review of the literature reveals a consensus of authoritative opinion that a shortage of skilled mechanics exists today in the automotive service and repair industry. A frequently cited reason for this is the generally unfavorable attitude of young men toward the auto mechanics' trade. An examination of the auto mechanic job market indicates that there is some justification for such behavior on the basis of working conditions, wages and status.

4.3.1. WORKING CONDITIONS.

Historically garages have projected a poor image as a place in which to work. While this image is not universally deserved, it is nevertheless universally accepted. Lesh says that:

> ...despite attempts to glamorize and up-grade the field, the mechanic's job remains unattractive....dingy, back-alley shops, with working conditions to match, are still plentiful [4].

The Automobile Club of Missouri acknowledges that a high percentage of automotive repairs are unsatisfactory, and that this is attributable, in part, to poor working conditions in the garages [52]. It further states that, while it is possible to keep a garage neat, clean and attractive, a great many of them are dark, dirty, and untidy, thus making it difficult to attract or hold good men. In addition, the report indicates that the high incidence of worn out, inadequate, and obsolete equipment also discourages many from entering the trade or remaining in it.

An interview with the service manager of a dealership garage in Ann Arbor [53] revealed that the old image does not apply to the newer, larger garages. This particular garage, which is typical of the establishments built within the last few years, is well lighted, well ventilated, comfortably heated or cooled, clean, spacious, expertly laid out, and it provides excellent restroom and lounge facilities for the employees as well as the customers.

In order to evaluate the extent to which the job market is affected by working conditions, the industry is analyzed here in terms of the distribution of sales and employees. This study assumes that working conditions are a consequence of the size and age of the shop; that size and age are a function of the legal form of ownership; and that old or small garages are more prone to poor working conditions than new or large garages.

Table 13 gives the distribution of establishments, sales, and employees among the various forms of establishment ownership. While this does not show the quality of working conditions, it demonstrates that corporations characteristically employ a larger staff and produce greater income per establishment. It is inferred from this that corporations operate the majority of the new and larger plants where good working conditions are most likely to exist.

TABLE 13. DISTRIBUTION OF ESTABLISHMENTS, SALES AND EMPLOYEES ACCORDING TO LEGAL FORM OF OWNERSHIP [47]

Form of Ownership	No. of Establishments	Sales	Employees (Total)	Sales Per Establishment	Employees Per Establishment
		DEALERSHIPS			
Individual Proprietor	9,997	4,302	88,221	0.43	8.82
Partnership*	4,414	2,850	56,888	0.65	13.07
Corporation	18,968	30,222	484,896	1.59	25.56
Total	33,379	37,374	630,005	1.11	18.87
		REPAIR SHOPS			
Individual Proprietor	93,120	2,099.8	197,431	0.23	2.12
Partnership**	13,611	576.9	50,060	0.42	3.67
Corporation	7,699	908.6	57,119	1.18	7.41
Total	114,430	3,585.3	304,610	0.31	2.66

---

*Cooperatives and other legal forms constitute 0.1% of the total and are included with partnerships.

**Cooperatives and other legal forms constitute 0.22% of the total and have been disregarded.

Table 14 shows to what extent each form of ownership influences the job market. Establishments, sales and employees are given in percent of the respective totals so that the differences will be more readily apparent. The table indicates that corporations dominate the dealership job market, while individual proprietors dominate the repair shop market. Although this may simply reflect the superiority of the corporation in the

TABLE 14. LEGAL FORM OF OWNERSHIP AND PERCENT OF ESTABLISHMENTS, SALES AND EMPLOYEES [47]

Form of Ownership	Dealers			Repair Shops		
	Establishments	Sales	Employment	Establishments	Sales	Employment
Individual Proprietor	29.9	11.5	14.0	81.3	58.5	64.8
Partnership	13.2	7.6	9.0	11.8	16.0	16.4
Corporation	56.8	80.8	76.9	6.7	25.3	18.7

business of financing an inventory of automobiles, it nonetheless demonstrates that dealership garages generally present a better working place image than do the independent shops.

Table 14 also indicates that a very high proportion of all garages are operated by small entrepreneurs. This is illustrated in greater detail in Table 15, in which establishments are classified according to number of employees. The distribution of establishments, sales and personnel in this case demonstrates that the majority of shops are the small ones in which, it is assumed, the working conditions are most likely to be poor or marginal.

According to Table 15, dealerships that employ seven people or less account for 36.8 percent of those shops, while comparable independents account for 95.9 percent. Shops of this size total 111,081, or 82.5 percent of the 133,903 establishments included in Table 15. In other words, these shops employ 256,656 people, or 38 percent of the 671,736 total. Nationwide, the small shop permeates the industry; 82.5 percent of all garages and 38 percent of all automobile service and repair workers have historically projected an image of poor working conditions.

TABLE 15. DISTRIBUTION OF ESTABLISHMENTS, SALES AND EMPLOYEES ACCORDING TO EMPLOYMENT SIZE OF ESTABLISHMENT [47]

Size of Establishment	No. of Establishments	Sales in Millions	Total Employees	Percent of Establishments	Percent of Sales	Percent of Employees
			DEALERSHIPS			
0* - 3	4,992	684	9,666	16.8	2.8	2.4
4 - 7	5,933	1,937	32,447	20.0	8.1	8.0
8 - 14	7,886	4,667	84,304	26.6	19.6	20.9
15 - 49	10,812	16,440	275,751	36.4	69.2	68.5
50** - up	2,303	--	--	--	--	--
Total	29,623	23,728	402,168	99.8	99.7	99.8
			REPAIR SHOPS			
0* - 3	91,193	1,739	161,544	87.4	52.8	59.9
4 - 7	8,963	739	52,999	8.5	22.4	19.6
8 - 14	3,131	488	33,254	3.0	14.8	12.3
15 - 49	993	324	21,771	0.9	9.8	8.0
50** - up	48	--	--	--	--	--
Total	104,280	3,290	269,568	99.8	99.8	99.8

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*Includes proprietors who are not classed as paid employees.

**Data on sales and employees withheld to avoid disclosure; these establishments are not included in the total of establishments.

The foregoing assumption states that good working conditions depend upon the ability of the specific business to provide an environment in which the unpleasant aspects of automotive work are minimized. It is expensive to provide a facility that eliminates or moderates these unpleasantries, which explains why it is necessary for a company to be quite successful in order to overcome the difficulties. A review of the circumstances of automotive work gives some indication of the nature of the problems that must be overcome.

The U.S. Department of Labor describes the work of the automobile service mechanic in Selected Characteristics of Occupations [54], a supplement to the Dictionary of Occupational Titles. In this document, occupations are described in terms of the physical demands of the occupation and the characteristics of the working conditions. There are six classes of physical demands and seven classes of working conditions. The automobile service mechanic is described by items 1, 3, 4 and 5 of the physical demands and items 1, 5 and 7 of the working conditions. They are as follows:

Physical Demands

1 Lifting, Carrying, Pushing, and/or Pulling (Strength):

  (1) Lifting: Raising or lowering an object from one level to another (includes upward pulling).

  (2) Carrying: Transporting an object, usually holding it in the hands or arms or on the shoulder.

  (3) Pushing: Exerting force upon an object so that the object moves away from the force (includes slapping, striking, kicking, and treadle actions).

  (4) Pulling: Exerting force upon an object so that the object moves toward the force (includes jerking).

Note: Group 1 under Physical Demands is further classified as S (sedentary), L (light work), M (medium work), H (heavy work), and V (very heavy work). Automobile mechanics are classed as M, which is defined as "lifting 50 pounds maximum with frequent lifting and/or carrying of objects weighing up to 25 pounds."

3. Stooping, Kneeling, Crouching, and/or Crawling:

   (1) Stooping: Bending the body downward and forward by bending the spine at the waist.

   (2) Kneeling: Bending the legs at the knees to come to rest on the knee or knees.

   (3) Crouching: Bending the body downward and forward by bending the legs and spine.

   (4) Crawling: Moving about on the hands and knees or the hands and feet.

4. Reaching, Handling, Fingering, and/or Feeling:

   (1) Reaching: Extending the hands and arms in any direction.

   (2) Handling: Seizing, holding, grasping, turning, or otherwise working with the hand or hands (fingering not involved).

   (3) Fingering: Picking, pinching, or otherwise working with the fingers primarily (rather than with the whole hand or arms in handling).

   (4) Feeling: Perceiving such attributes of objects and materials as size, shape, temperature, or texture, by means of receptors in the skin, particularly those of the finger tips.

5. Talking and/or Hearing:

   (1) Talking: Expressing or exchanging ideas by means of the spoken word.

   (2) Hearing: Perceiving the nature of sounds by the ear.

Working Conditions

1. Inside, Outside, or Both:

   A job is considered "inside" if a worker spends 75% or more of his time inside, and "outside" if he spends 75% or more of his time outside. A job is considered "both" if the activities occur inside or outside in approximately equal amounts.

   (Automobile mechanics are classified as "both".)

5. Noise and Vibration:

   Sufficient noise, either constant or intermittent, to cause marked distraction or possible injury to the sense of hearing, and/or sufficient vibration (production of an oscillating movement or strain on the body or its extremities from repeated motion or shock) to cause bodily harm if endured day after day.

7. Fumes, Odors, Toxic Conditions, Dust, and Poor Ventilation:

   (1) Fumes: Smoky or vaporous exhalations usually odorous, thrown off as the result of combustion or chemical reaction.

   (2) Odors: Noxious smells, either toxic or non-toxic.

   (3) Toxic Conditions: Exposure to toxic dust, fumes, gases, vapors, mists, or liquids which cause general or localized disabling conditions as a result of inhalation or action on the skin.

   (4) Dust: Air filled with small particles of any kind, such as textile dust, flour, wood, leather, feathers, etc., and inorganic dust, including silica and asbestos, which make the workplace unpleasant or are the source of occupational diseases.

   (5) Poor Ventilation: Insufficient movement of air causing a feeling of suffocation or exposure to drafts.

4.3.2. WAGES. There is general agreement in the literature that auto mechanic wages are inadequate, although this does not always hold in the case of the man who is competent, industrious, and highly productive. Schurer makes the point [55] that the difficulty lies more in the spread in wages between auto mechanics and other workers of equivalent skill who work in the same locality, than in regional differences in wage level. Table 16 illustrates wage differences among six occupations requiring comparable skill levels.

Lesh [4] agrees that mechanic salaries are low in comparison to trades requiring similar amounts of skill, but disagrees as to the importance of regional differences in pay. He quotes data from a 1962 survey conducted by NADA that reports a mechanic wage of $83 a week in the South Atlantic region and $113 per week in the Pacific coast area. The difference, according to Lesh,

TABLE 16. AVERAGE HOURLY EARNINGS FOR SELECTED OCCUPATIONS IN METROPOLITAN AREAS FOR ALL INDUSTRIES, BY REGION, 1967 [56]

Occupation	All Metropolitan areas	North East	South	North Central	West
Carpenters	$3.42	$3.30	$3.30	$3.58	$3.54
Electricians	3.61	3.46	3.47	3.74	3.77
Machinists	3.59	3.49	3.50	3.67	3.78
Painters	3.37	3.18	3.24	3.58	3.59
Tool and Die Makers	3.79	3.55	3.56	3.92	3.95
Mechanics, automotive	3.36	3.33	3.04	3.46	3.74

may be due to the extent of union organization in the west coast shops. Table 17 shows the regional averages for auto mechanics

TABLE 17. AVERAGE HOURLY EARNINGS FOR AUTOMOBILE MECHANICS IN METROPOLITAN AREAS, BY INDUSTRY DIVISION AND REGION, 1967 [56]

Auto Mechanic Employment	All Metropolitan areas	Northeast	South	North Central	West
All Industries	$3.36	$3.33	$3.04	$3.46	$3.74
Manufacturing	3.32	3.33	2.87	3.45	3.64
Non-Manufacturing	3.38	3.33	3.10	3.46	3.79
Transportation, Communications and Public Utilities	3.40	3.32	3.15	3.48	3.82
Wholesale Trade	3.28	3.50	2.91	3.34	3.62
Retail Trade	3.21	-	2.86	3.43	3.67
Selected Services	3.22	3.38	2.71	3.34	-

employed in six categories of industry.

Winpisinger is quoted to have said [34] that auto mechanics are underpaid in comparison to other skilled tradesmen, particularly those of the building trades, but he does not see this as an area in which union involvement can easily exert pressures to force improvement. He points out that, while unions have had some success in the larger shops, especially on the west coast, it is difficult to deal with the small shops since there are a great many of these in which the proprietor is the principal mechanic. Table 18 shows the extent of small shop employ-

TABLE 18. WAGE RATE BY EMPLOYMENT SIZE [47]

Employment Size of Establishment	No. of Establishments	No. of Employees*	Payroll, Entire Year ($1,000)	Pay per Employee
		FRANCHISED PASSENGER CAR DEALERS		
0 - 3	4,992	9,666	43,706	4,418
4 - 7	5,933	32,447	137,807	4,247
8 - 14	7,886	84,307	381,960	4,530
15 - 49	10,812	275,751	1,519,756	5,511
50 - over	2,313	NA	NA	NA
		AUTO REPAIR SHOPS		
0 - 3	88,890	161,544	258,791	1,601
4 - 7	8,963	52,999	205,785	3,882
8 - 14	3,131	33,254	151,920	4,568
15 - 49	993	21,771	103,925	4,773
50 - over	48	NA	NA	NA

NA: Not available

*Number of employees includes active proprietors of unincorporated businesses.

ment, and its influence on mechanic wages.

Snow [10] approaches the problem of mechanic wages from a different aspect, tying wages to the allocation of mechanics. He contends that since mechanics do not enjoy a particularly high social position, it is unlikely that prestige would play a significant role in the mechanic's employment decision. He finds that higher wages are a decisive factor in mechanic mobility; 87 percent of the mechanics he surveyed took their present job because it involved a pay increase. He concludes that the movement of mechanics to obtain higher wages is the principal mechanism through which this labor market operates. This seems to be confirmed by the distribution of mechanic wages according to the size of the shop and the form of ownership.

Table 19 shows the relationship of wages to form of owner-

TABLE 19. WAGE RATE BY LEGAL FORM OF ORGANIZATION: FRANCHISED PASSENGER CAR DEALERS [47]

Form of Organization	No. of Establishments	No. of Employees*	Payroll, Entire Year ($1,000)	Pay per Employee
FRANCHISED PASSENGER CAR DEALERS				
Individual Proprietors	9,997	88,221	323,326	3,767
Partnerships	4,340	56,888	212,985	3,743
Corporations	18,968	484,896	2,776,657	5,726
AUTO REPAIR SHOPS				
Individual Proprietors	93,120	197,431	399,580	2,063
Partnerships	13,611	50,060	94,316	1,884
Corporations	7,699	57,119	283,794	4,968

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*Number of employees includes active proprietors of unincorporated businesses.

ship. While these figures include all employees, not just mechanics, they indicate the generally greater ability of the corporation to compete in the job market, particularly where the corporation is a dealership organization.

The flat rate system is often cited as a cause of difficulty in auto mechanics' wage structure. This is an incentive plan under which the mechanic receives a percentage, usually between 45 and 55 percent, of the labor cost charged against a repair job. Since the customer is frequently billed according to the time quoted in the flat rate manual, the mechanic stands to improve his hourly income if he is able to complete the job in less than the time listed. Lesh [4] points out that shops operating on this system find it difficult to train new men, since the experienced man is often unwilling to jeopardize his own income in order to help or instruct the inexperienced youngster.

The Auto Club of Missouri [52] agrees that the flat rate system is fine in theory, but they find that the plan lends itself to many abuses. It emphasizes speed over quality, and, while a poor job is supposedly done over free of charge, this seldome happens in practice.

Robert Straub, president of the Independent Garage Owners of America, pointed out in an interview [57] that, although the flat rate system makes it more difficult to survive the job entry period, mechanics who succeed are frequently able to take home wages in excess of $200 or $250 a week. While wages on this level do not occur only in the flat rate mode, it demonstrates, according to Straub, that the potential is there, and that garage operators are in some degree falsely accused of perpetuating substandard wages. Young [53] also commented on the pay of the mechanic, indicating that the dealership garages in the Ann Arbor area charge about ten dollars an hour for repair work and divide this about fifty-fifty with the mechanic.

Thus, it is easily possible for a skilled mechanic to exceed $200 per week in take-home pay. This is further verified by Schick [58], owner-operator of a European automobile sales and repair service in Pontiac, Michigan, who indicated that his top mechanics normally exceed $200 a week and have on some occassions exceeded $300 a week in take-home pay.

4.3.3. STATUS. In a report to the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, the Auto Club of Missouri [52] states:

> The general public does not, it seems, think highly of mechanics. Whether the opinion is justified or not is beside the point; it is what people believe that affects the attitude of mechanics towards the general public and their own work. It also makes it hard to recruit good men to the industry.

The report also points out a tradition of mistrust between garage and customer, a carry over from the days of horse trading when the buyer tried to cheat the seller, and vice versa. The tradition of sharp practices still clings to the image of the mechanic.

The new, modern service plant conveys an impression of expertise and success; it should also generate an aura of high status. The motorist is frequently dissatisfied in his dealings with the "better" places, however, and is often justified in feeling that he has come out second best. Since it is usually the mechanic who directly or indirectly gets the blame, it is the mechanic who suffers loss of status in the public view.

The small shops, which are so prevalent in the industry, also exert a negative influence on the image of the mechanic. These places suffer from poor customer relations the same as the newer places do, and the status of the mechanic suffers accordingly. In addition, the small shops are directly tied to the dirty, dingy, back-alley connotation previously discussed. The small shop reinforces the motorist's suspicion of even the best shops.

Lesh points out [4] that, especially for school-age youth, there is a certain status value in being knowledgeable enough to repair one's own car; there is much less status in doing this type of work for a living. In the early days of the automobile, the mechanic was something of a village genius, and was treated with a great deal of respect. Following World War II, however, automobile maintenance was a routine and mundane affair, while new fields such as aircraft, television, and electronics became glamorous.

The problem of prestige and status is not a new one, nor does it apply exclusively to the automotive service and repair industry. Sociologists have been observing the effects of occupation on status and vice versa, for many years. Isaacson reports [59] on rating scales that date back to 1925; his major effort, however, is a comparison of data gathered by North and Hatt in 1947 and a replication of that study in 1963 by Hodge, Siegel and Rossi. On this scale, U.S. Supreme Court Justices were ranked number 1 and shoe shiners were ranked number 90: Automobile repairmen ranked 59.5 in 1947 and 60 in 1963, while garage mechanics ranked 62 in 1947 and 65.5 in 1963, indicating that there has been a slight downward trend in mechanic status during the years between these two studies.

Hodge, Siegel and Rossi found [60] that there was a high positive correlation between the 1963 and 1947 studies. Their analysis indicates that blue-collar workers, in general, show higher scores in the 1963 study, indicating an upward movement of status. Automobile repairmen and garage mechanics' scores moved up less than did the scores of other blue-collar workers, however, resulting in a lower rank of status for the auto mechanic.

More recently, Robinson, Athanasiou and Head reported [61] on the Duncan system of occupational ratings and compared it to the previous work of Hatt, North, Hodge, Siegel and Rossi. In the latter listing, the various occupations are classified according to score. U.S. Supreme Court Justices are 96 in 1947 and 94 in 1963, according to the National Opinion Research Center (NORC) studies, and shoe shiners have a score of 33 and 34, respectively, for these dates. The Duncan system scores the Supreme Court Justice at 93 and the shoe shiner at 08, thus they are easily comparable in terms of real numbers. Table 20

TABLE 20. OCCUPATIONAL RATINGS ACCORDING TO NORC AND DUNCAN SCORES [61]

Occupation	NORC 1947	NORC 1963	Duncan
U.S. Supreme Court Justice	96	94	93
Scientist	89	92	81
Airline Pilot	83	86	79
Building Contractor	79	80	51
Electrician	73	76	44
Trained Machinist	73	75	33
Carpenter	65	68	19
Automobile Repairman	63	64	19
Plumber	63	65	34
Garage Mechanic	62	62	19
Machine Operator (Factory)	60	63	16
Filling Station Attendant	52	51	19
Night Watchman	47	50	18
Shoe Shiner	33	34	08
Average	69.8	71.0	

shows occupational ratings, in terms of NORC scores and Duncan scores, of a selected range of occupations including those requiring a level of skill comparable to the auto mechanic.

While in this table the mechanic is slightly below average on the NORC prestige score, remember that mechanics are 60th out of a possible 90 rank on the NORC scale. The Duncan rating is based on the 1950 census and leans heavily on average income and educational level, hence is not well suited to occupational categories in skilled trades. It nevertheless indicates that automobile mechanics fall below the level of the skilled construction tradesmen.

Job status may be more important in real life than either wages or working conditions when it comes to career choice. Gross says [62] that society, like any person in it, will pay as little for a service as possible; and the reward for an activity depends, in part, on what society can be required to pay. Where young men avoid an occupation because it is held in low esteem, those who do follow the trade are likely to experience greater difficulty in persuading the society to pay for services rendered.

4.4. LABOR FORCE

4.4.1. TASKS IN TERMS OF JOB TITLES.

Job descriptions provided by the Department of Labor [8] were adopted in this study as the basic definitions of the various occupational levels required in the operation of automotive service and repair organizations such as dealerships, independent garages, and service stations. The following are summaries of the DOT job descriptions of four of the most common personnel categories in the auto service industry:

> Automobile Mechanic (auto service) 620.281. Repairs and overhauls automobiles, buses, trucks, and other automotive vehicles. Removes unit, such as engine, transmission,

or differential; disassembles unit and inspects for wear, damage, or malfunction. Repairs or replaces parts as required in accordance with manufacturers' specifications or manuals. May overhaul or replace items such as carburetors, blowers, generators, distributors, starters, and pumps. In addition to mechanic's hand tools may operate lathes, shapers, drill presses, and welding equipment. May install or repair accessories, such as radios, heaters, mirrors, and windshield wipers.

Automobile Mechanic Helper 620.884. Assists automobile mechanic to repair automobiles, buses, trucks, and other automotive vehicles, performing the following duties: May remove and disassemble units such as engine, transmission, or differential using hand tools and power tools. Performs other duties as described under "helper" (any industry).

Automobile Service Mechanic I 620.381. Automotive Service Specialist. Performs minor repair and tune-up of motor vehicles, replaces and adjusts fuel, electrical and cooling system components, such as carburetor, fuel and water pumps, distributor, voltage regulator, coil, and generator using hand tools. Replaces and adjusts system components parts such as distributor breaker points and generator brushes. May replace defective chassis parts, such as shock absorbers, tie-rod ends, ball joint, suspension, brake shoes and wheel bearing. May install automobile accessories, such as oil and air filters, windshield wiper blades, fan belts, and batteries. May also perform oil drainage and lubrication jobs. When working in a service station, may be designated Automobile Service Station Mechanic.

Automobile Service Station Attendant 915.896. Services automobiles, buses, trucks, and other automotive vehicles with fuel, lubricants and accessories: Fills fuel tank of vehicles to level specified by customer. Adds water and oil as necessary; lubricates vehicle and changes motor oil. May replace oil filter, air filter, windshield wiper blades, and fan belt.

The term "automotive mechanic" may include several other occupational titles [49]. Table 21 illustrates the extent to which specialization occurs, but does not include all of the job titles. While it gives a good indication of the division of labor and the range of occupations within the automotive service and repair industry, it does not necessarily show the job titles under which the individual is hired.

TABLE 21. AUTOMOTIVE SERVICE OCCUPATIONS LISTED IN THE DICTIONARY OF OCCUPATIONAL TITLES

Repair-service salesman
Automobile tester
Carburetor man
Front-end man
Tune-up man
Air-conditioning mechanic
Automobile mechanic
Automobile mechanic (apprentice)
Brakeman, automobile
Motorcycle repairman
Transmission mechanic
Brake adjuster, auto
Clutch rebuilder
Squeak, rattle, and leak man
Automobile mechanic helper
Spring repairman
Bonder, automobile brakes
Generator and starter repairman
Propulsion motor and generator repairman
Auto body repairman
Electrician, automobile
Brake-drum-lathe operator

The occupational titles in the Bureau of Labor Statistics' tables are the same as the comparable Census occupational categories [49]. In other words, it appears that the term "automotive mechanic," as used by the Bureau of the Census and the Bureau of Labor Statistics, is a broad definition which includes the occupation of automobile mechanic as well as a number of specific occupations that are found within the automotive service and repair industry.

The Bureau of Labor Statistics published a list of eight categories of automotive service occupations, and briefly described the work, the working conditions, employment opportunities, wages, and other pertinent information [63]. The eight categories are as follows:

(1) Automobile, truck, and bus mechanic
(2) Body repairman
(3) Gas station attendant
(4) Automobile painters
(5) Parts counterman
(6) Automobile salesman
(7) Service advisor
(8) Automobile trimmer, installer, and upholsterer

These categories are based on the classifications in the Dictionary of Occupational Titles, but they are grouped into occupational areas rather than into occupational specialties.

The National Automotive Technicians Certification Board (NATCB) recently initiated an industry-wide system of voluntary certification of automotive mechanics [64]. NATCB is composed of representatives of three national automotive associations: The Automotive Service Industry Association, The Independent Garage Owners of America and The National Congress of Petroleum Retailers. This program recognizes 15 automotive mechanic classifications. The NATCB developed these job titles by grouping together tasks that are related either to a specific subsystem of the vehicle or to a specific skill. Table 22

TABLE 22. MECHANIC CLASSIFICATIONS BASED ON IGOA MECHANIC CERTIFICATION PROGRAM

A. Engine Overhaul
B. Electrical
C. Carburetion
D. Cooling System
E. Braking System
F. Automatic Transmission
G. Front Suspension
H. Air Conditioning
I. Power Train and Standard Transmission
J. Standard and Power Steering
K. Body and Fender
L. Paint
M. Glass
N. Truck Repairman
O. Frame

lists the task areas in which a mechanic may be certified; a mechanic wishing to qualify for a Master Technician Certificate will be required to successfully complete eight of the first ten examinations, i.e., from A through J.

Motor vehicle safety inspector is an additional auto mechanic job title. The requirements of vehicle inspection vary so much from one motor vehicle jurisdiction to another, however, that it is difficult to classify inspectors. Thirty of the thirty-two states currently enforcing PMVI laws allow qualified mechanics who are employed in privately owned automotive repair and service establishments to conduct motor vehicle inspections in conjunction with their normal work. Consequently, the majority of these men perform both inspections and maintenance work. In either case, the basic skill requirement is that of automotive mechanic even where the primary task is inspecting automobiles rather than repairing them. Booz, Allen, and Hamilton [17] report that only slight additional training is needed to upgrade an automobile mechanic to motor vehicle inspector.

Many rapair tasks appear and disappear according to the state of the technology and the dictates of style. The prefocused sealed beam headlight, for example, eliminated the need to focus, but did not eliminate the need to aim. For all practical purposes, this improvement did not result in a reduction of manpower, since the growth of the vehicle population has more than offset the savings in manpower that resulted from the elimination of the focusing operation. Practices involving more complex operations, however, such as engine rebuilding and the repair and overhaul of starters, generators, and other accessories, have had a significant effect on the labor force; both in the distribution of the labor and in the skills required of the worker.

The automotive service and repair industry has found that, in general, it is economically more realistic to replace defective units rather than to repair them. The "remove and replace" technique permits the shop to handle a larger volume of work; it increases customer satisfaction (given proper handling of the job and a line of reliable replacement parts); and it allows the establishment to operate with fewer highly skilled personnel. Production line overhaul methods represent a substantial savings in manpower and at the same time relieve the need in the industry for men who are sufficiently skilled to analyze component defects, perform the necessary repair work and return the unit to service in properly operating condition. The effect on the labor force is to lower the number of workers required to maintain "X" number of automobiles and to lower the general skill level required by the industry [10].

4.4.2. ESTABLISHMENTS IN TERMS OF JOB TITLES. Whatever technological and economic developments occur, the labor force is expected to experience an increased demand for automotive service and repair workers, especially mechanics. Bedel [26] shows that there are 1.5 million men currently engaged in motor vehicle service and repair in this country. Tomorrow's Manpower Needs [49] states that approximately 785,000 men were employed as automotive mechanics in 1966, and projects this figure to 940,000 by 1975. These figures include automobile, truck and bus mechanics, as well as body repairmen; the report states that three quarters of these workers are automobile mechanics, thus indicating that a distinction is made between automotive mechanics and automobile mechanics. Table 23 presents the distribution of automotive and automobile mechanics as it is reported in this source.

Tomorrow's Manpower Needs [49] also reports that mechanic employment rose from 650,000 in 1950 to 785,000 in 1966, an

TABLE 23. DISTRIBUTION OF MECHANICS AMONG MAJOR EMPLOYER GROUPS [49]

Group Employer	Percent Total*	Automotive		Automobile	
		1966	1975	1966	1975
All groups	100	785,000	940,000	588,750	705,000
Independent Shops	40	314,000	376,000	235,500	282,000
Dealership (new and used)	25	196,250	235,000	147,187	176,250
Fleet Operations	10	78,500	94,000	58,875	70,500
Gas Station and Dept. Stores	25	196,250	235,000	147,187	176,250

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*Percentages are all approximate.

increase of about 20 percent. It indicates that the number of vehicles in use, which is the principal determinant of mechanic employment, increased about 88 percent in the same time period. This disparity in rates of growth is explained as a result of the abrupt decline in the average age of vehicles following World War II (i.e., high scrappage rate of pre-war vehicles and high production rate of post-war vehicles) and the consequent declining requirement for vehicle maintenance performed by automotive mechanics.

These projections do not take into account the possibility that a shortage of mechanics exists; they simply reflect the current level of employment. Using these data, however, the increase in the mechanic population is calculated at 17,222 men per year between 1966 and 1975. Replacements due to attrition during this period will require an additional 24,150 men per year (based on an average mechanic age of 35 years), bringing the total annual requirement to approximately 41,372 men.

Since the review of the literature indicates that there is a substantial shortage of mechanics, an estimate of the manpower requirements for the industry should make an allowance for this factor. Table 24 compares actual and estimated conditions to projected conditions, using the ratio of 100 vehicles per mechanic as the criterion of a reasonable mechanic work load. The implication here is that it will be necessary to increase the employment figure by 45,000 men yearly in order to avoid a potential shortage of 270,000 mechanics by 1975. When this figure is added to the 17,222 for annual growth and the 24,150 for annual attrition, the total requirement from 1969 to 1975 is 86,327 mechanics per year. Following 1975, the yearly requirement will revert to about 41,000 men, depending upon the conditions then prevailing.

TABLE 24. NUMBER OF MECHANICS REQUIRED, 1969-1975

1969		1975	
Vehicles, Actual	100,000,000	Projected	121,000,000
Mechanics, 100:1	1,000,000	Projected	1,210,000
Mechanics, 120:1 (est.)	836,666	Projected, 127:1	940,000
Mechanic shortage	163,334	Projected shortage	270,000

While the above figures may seem somewhat extreme in the light of projections, they do not miss by much the predictions developed by Leonard Lecht [32]. He considers the sixteen sectors of the public and private economy which account for virtually all of the national production. He projects the 1975 employment level that is likely to occur in every occupation in each of these sectors, and designates these employment figures as "bench mark estimates." He then predicts what the employment level should be in each occupation, in each sector, in order to achieve an overall improvement in the pattern of American life by 1975; these are designated "aspiration goals."

When all of the automotive mechanic employment figures from Lecht's study are summed, they are 51,000 less than the figure produced by the 100:1 vehicle-mechanic ratio for 1975 shown in Table 24. Lecht's totals appear as follows:

1962	673,000	Benchmark estimate, 1975	932,000
1964	758,000	Aspiration goal, 1975	1,159,000

A complete listing of Lecht's automotive mechanic data is given in Table 25, which, incidentally, also presents a very good

TABLE 25. EMPLOYMENT PROJECTIONS FOR 1975 FOR AUTOMOBILE MECHANICS AND REPAIRMEN BY INDUSTRY [32]

Industry	Benchmark Estimates	Aspiration Goals
Agriculture	1,000	2,000
Mining	1,000	1,000
Construction	8,000	12,000
Manufacturing		
Durables	34,000	46,000
Nondurables	10,000	12,000
Transportation	78,000	99,000
Public Utilities	6,000	7,000
Communications	1,000	1,000
Trade		
Wholesale	17,000	21,000
Retail	613,000	752,000
Services		
(Other than Private Household)	145,000	185,000
Public Administration	17,000	22,000
All Industries	932,000	1,159,000

picture of the distribution of auto mechanics across all segments of the economy.

4.5. LABOR FORCE CHARACTERISTICS

The automotive service and repair industry, in general, describes its labor force requirements in terms of mechanic characteristics such as experience, competency, training, and ability, even though about half of its workers do not fall in the mechanic classification. Since no sharp dividing line exists between mechanic and nonmechanic in actual practice, other criteria, such as age, educational attainment, marital status, and race should be considered in performing an overall evaluation of the industry. Likewise, it is important to consider projections of economic and employment trends, since they contain important implications for the procurement and training of mechanics in the future.

Lecht anticipates [32] a continued growth in population, employment, income and gross national produce (GNP), at least through the 1970's. Table 26 presents this information in condensed form. It indicates that there will be extensive changes in both the social and the economic climate of the near future. It supports the assumption found in the literature that vehicle

TABLE 26. NATIONAL GROWTH OF SELECTED ITEMS, 1962 to 1975 [32]

	Actual ($)		Projected($)
Item	1962	1964	1975
GNP (billions)	573	622	1,010
Population (millions)	187	192	226
Civilian Labor Force (millions)	72	74	91
GNP per Capita	3,064	3,240	4,470
Average Family Income	7,450	7,800	10,350

population and the demand for automotive services will continue to increase, and that there will be a growing need for skilled automotive mechanics. But it gives no indication as to what the characteristics of the mechanic population will be.

4.5.1. RACE, SEX AND RURAL/URBAN DISTRIBUTION. The distribution of the experienced labor force, in terms of race, sex and rural/urban location, is shown in Table 27. Six occupations that require comparable skill levels are included. The data are based on the 1960 census of the population [65].

TABLE 27. CHARACTERISTICS OF SELECTED OCCUPATIONS BY RACE, SEX AND RURAL/URBAN DISTRIBUTION [65]

Occupation	Labor Force (experienced)	% White	% Negro	% Other Races	% Female	% Urban	% Rural Non Farms	% Rural Farms
Carpenters	924,460	94.6	4.5	.8	.335	59.0	34.3	6.6
Electricians	358,202	97.9	1.4	.6	.716	74.8	23.0	2.1
Machinists	516,387	97.0	2.5	.4	1.453	78.8	18.8	2.3
Painters	420,303	92.3	6.9	.7	1.948	77.4	20.2	2.2
Tool and Die Makers	186,200	98.8	.9	.1	.702	82.1	15.9	1.9
Mechanics, Automotive	705,380	92.5	6.6	.8	.363	67.4	29.0	3.4
Total Labor Force	68,006,553	89.3	9.7	.8	32.7	73.2	19.5	7.1

Since these data are based on the 1960 census, they should be interpreted with care. Both the racial balance and the rural/urban distribution may have changed considerably since these statistics were compiled. According to this table, the automotive service and repair industry is somewhat more receptive to the non-white worker than the other skilled trades (except painting), although it is not as accomodating as the total labor force. The very low percentage of females in the trade is not surprising, although in real numbers there were 2,563 experienced female automotive mechanics in the labor force in 1960. It is also interesting to note that carpenters and mechanics are more evenly distributed between urban, rural and farm than are either of the other skilled trades or the total work force.

4.5.2. GEOGRAPHIC MOBILITY. Another characteristic of the auto mechanic that is frequently discussed in the literature is the incident of geographic mobility. Table 28 compares the auto mechanic with carpenters, electricians, machinists, painters, tool and die makers and the total male labor force. There is no way to tell from these data at what age or how many times the individual may have moved from one locality to another. Nor do the data indicate how often the individual may have moved from employer to employer within the community.

Table 28 does indicate, however, that auto mechanics are more likely to be native born Americans than craftsmen of the other occupations or than the total male labor force as a whole. It also appears that automotive mechanics are more likely to remain in the state in which they were born and raised, even though nearly a third of them were not residing in the state of their birth at the time of the census. The table shows that when a move is made, it is more likely to be made to a different region of the country than to a different state in the same region; this applies to the total labor force as well as the listed occupations. Automotive mechanics occupy the extremes in Table 28 only in terms of country of birth and residency in the state of birth; on all other counts they appear to be very much in the mid-range of geographic mobility, at least so far as the listed occupations and the total labor force are concerned.

TABLE 28. PERCENTAGE DISTRIBUTION OF MALE EXPERIENCED LABOR FORCE, BY GEOGRAPHIC MOBILITY, FOR SELECTED OCCUPATIONS [65]

Occupation	Total Number 1	Percent Native Born 2	Percent Foreign Born 3	Percent Residing in State of Birth 4	Percent Moved from State of Birth* 5	Percent Moved to Different State in Same Region 6	Percent Moved to Different Region 7
Carpenters	921,362	92.2	7.7	62.2	29.2	13.0	16.2
Electricians	355,636	94.7	5.2	61.9	32.1	14.2	17.9
Machinists	547,668	90.5	9.4	59.2	30.4	12.9	17.5
Painters	437,222	89.7	10.2	57.1	31.5	13.5	18.0
Tool and Die Makers	184,892	85.3	14.6	57.5	27.1	11.9	15.2
Mechanics, Automotive	702,817	95.7	4.2	64.4	30.5	13.4	17.1
Total Labor Force	45,713,381	93.4	6.5	60.4	29.7	13.0	16.6

* Percentages in Column 5 are sums of percentages in Columns 6 and 7.

4.5.3. WAGES EARNED AND HOURS WORKED. The review of the literature also reveals a strong interest in the income of the mechanic. Table 16 compared auto mechanic wages with the earnings of craftsmen of similar skill levels. The table indicated that automotive mechanics are the lowest paid of the six occupations, when compared on the basis of all metropolitan areas. Mechanics are lowest paid in the south and north central regions of the country, while painters and carpenters are paid lower average wages in the north eastern and western regions of the country.

Table 29 presents the distribution of hours worked per week for employees in six selected occupations and the total male labor force. The table indicates that comparatively few automotive mechanics work part time, while a much higher percentage of carpenters, painters, and the total male labor force work less than 40 hours a week. Less than a third of the mechanics work a standard 40 hour week. While slightly over a third work 40 hours or less, almost two thirds work more than 40 hours a week. In terms of hours worked per week, the auto mechanic is more intensely employed than either the total male labor force or the other skilled trades shown.

The data in Tables 16 and 29 are supported by a bulletin published by the Bureau of Labor Statistics [66]. The statistics are atypical in terms of automotive mechanics, however, since the populations surveyed are distinctly different from the universe with which the present study is concerned. The employees of the largest and least prosperous segment of the industry, the independent repair shops, are omitted entirely. The data include salesmen, office personnel, and common labor as well as mechanics. Consequently the statistics cannot be easily compared with those taken from the 1960 census report.

The bulletin contributes usefully to this study, however, since it reveals that pay is consistantly higher in metropolitan

TABLE 29. PERCENT DISTRIBUTION OF MALE EMPLOYED LABOR FORCE, BY HOURS WORKED PER WEEK, FOR SELECTED OCCUPATIONS [65]

Occupation	Total Number Working	1-14 Hours	15-29 Hours	30-34 Hours	35-39 Hours	40 Hours	41-48 Hours	49-59 Hours	60 Hours or More	40 Hours or Less	41 Hours or More	Average (Mean) Hours	% With Job Not At Work
Carpenter	791,066	4.7	7.9	6.3	5.6	49.3	16.7	6.0	3.0	74.0	25.9	38.9	3.5
Electrician	329,362	1.4	2.1	2.4	3.3	64.1	17.0	6.0	3.2	73.5	26.4	41.6	2.1
Machinist	482,152	.7	1.2	1.6	1.8	64.6	18.7	8.4	2.7	70.1	29.8	42.3	1.9
Painter	354,164	6.5	9.5	6.5	8.4	46.8	14.7	4.4	2.7	78.0	21.9	37.5	3.8
Tool and Die Maker	177,408	.4	.7	1.5	1.4	52.6	21.5	16.7	4.9	56.8	43.1	44.4	1.7
Mechanics, Automotive	671,642	1.9	2.2	1.4	1.4	28.9	32.3	19.2	12.4	35.9	64.0	46.8	1.5
Total Labor Force	42,558,076	4.4	4.6	3.0	4.4	41.5	19.5	10.3	11.8	58.1	41.8	43.2	2.1

areas than in non-metropolitan areas, and it consistantly increases as the sales-size of the establishment increases. Since this applies uniformly, although not equally, to all categories of employees included in the survey, it is likely that it also applies to the segments of the industry not included in the survey.

4.5.4. AGE OF WORKERS. Table 30 gives the distribution of ages for the same six occupations and for the total employed labor force. The statistics for auto mechanics, in this instance, are distinctly different from those of either the total labor force or the other selected occupations.

There is a substantially larger proportion of young workers and smaller proportion of old workers in the mechanic population. The differences are more pronounced between mechanics and the other tradesmen than between mechanics and the total labor force. Between the ages of 30 and 54 years, mechanics fall about in the middle of the spread of percentages. The median age of mechanics is 38.4 years, 2.1 years less than the total labor force and 4.72 years less than the average of the medians of the other skills. These data are plotted in graph form in Figure 2 for ease of comparison.

Since the median age of the youngest population (mechanics) differs from the median of the next youngest population (total male labor force) by only 2.1 years, it was decided that a test for statistical significance should be made. Using the formulae and tables given by McNemar [67], the difference was found to be significant at a confidence level in excess of 0.0001. In other words, the probability is less than one chance in 10,000 that this difference occurred because of coincidence or chance errors that might have affected the accuracy of the data. It may be inferred, therefore, that these populations are indeed significantly different in median age. A discussion of this problem, along with the formulae will be found in Appendix A.

TABLE 30. PERCENTAGE DISTRIBUTION AND MEDIAN AGE OF CIVILIAN LABOR BY AGE FOR SELECTED OCCUPATIONS [65]

Occupation	14-19 Years	20-24 Years	25-29 Years	30-34 Years	35-44 Years	45-54 Years	55-64 Years	65 Years and Over	Median Age (Years)	29 Years and Under	30-54 Years	55 Years and Over
Carpenters	2.24	6.38	8.54	10.46	25.66	23.69	17.21	5.82	43.7	17.60	59.81	23.03
Electricians	.89	6.18	11.13	14.60	28.65	22.34	13.80	2.41	41.8	18.20	65.59	16.21
Machinists	1.44	6.96	9.80	11.30	27.98	23.23	15.85	3.44	42.3	18.20	62.51	19.29
Painters	3.30	6.25	7.09	9.58	22.50	25.74	19.27	6.25	45.5	16.64	57.82	25.52
Tool and Die Makers	.70	5.19	9.13	11.81	31.55	22.90	15.54	3.18	42.3	15.02	66.26	18.72
Mechanics, Automotive	4.27	10.43	12.14	13.85	27.44	20.20	10.06	1.54	38.4	26.84	61.49	11.60
Total Male Labor Force	5.94	8.58	10.37	11.82	23.97	20.61	13.78	4.88	40.5	24.89	56.40	18.66

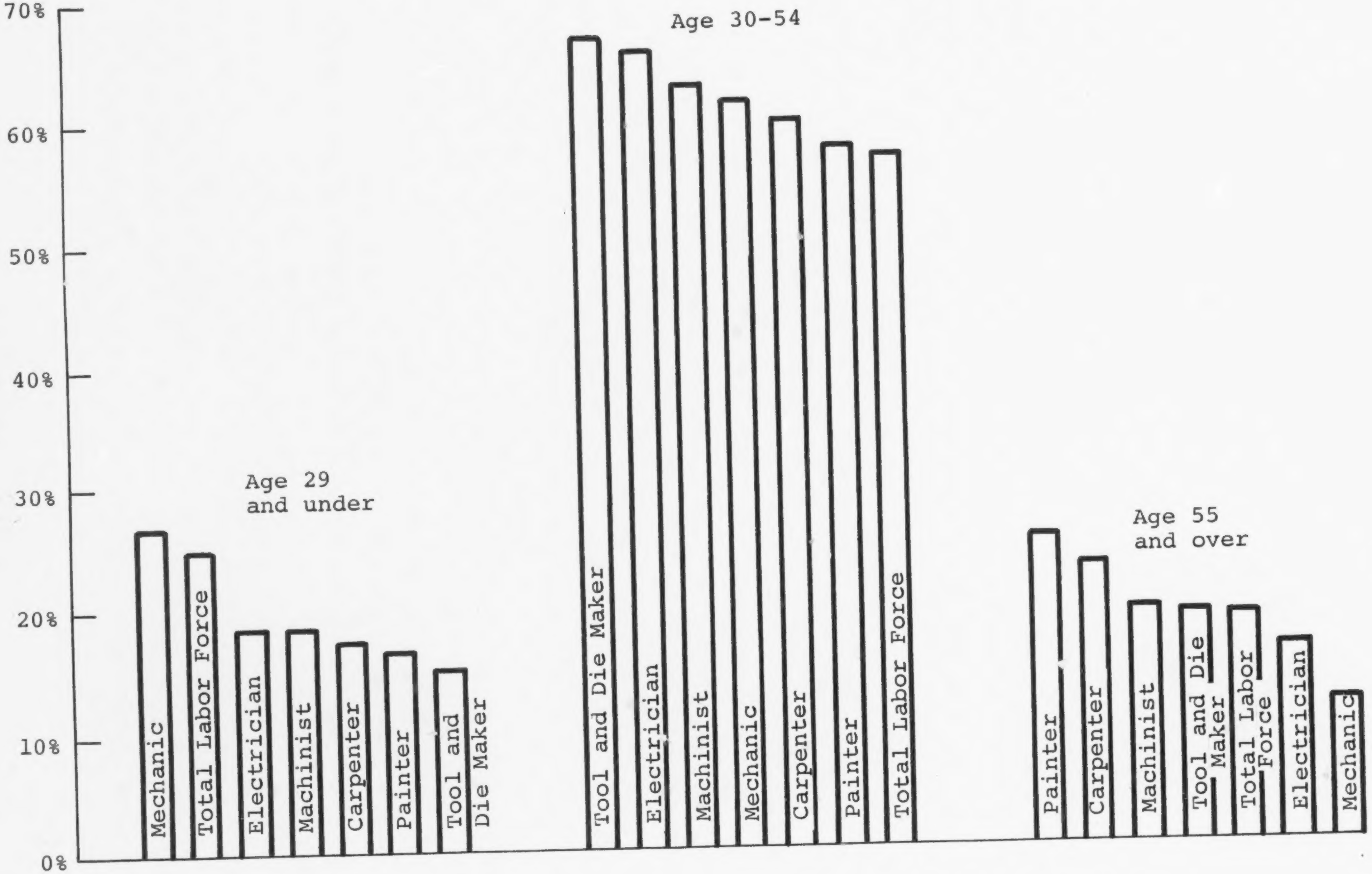

Figure 2. Rank order of occupations according to percent of employees in a given age bracket.

4.5.5. MARITAL STATUS. Automotive mechanics, the other selected skilled trades, and the total male labor force are also compared on the basis of marital status. These data, given in Table 31, are derived from a Bureau of Census survey of a five percent sample of the total population of each occupation. In this table, the percent of mechanics in a given category is compared with the percent of each of the other populations in the same category.

Since the sample sizes very considerably, the resulting percentages do not necessarily provide a reliable basis of comparison. Consequently, the data were subjected to a test for significant difference between two proportions [67]. Since a "Z" of 1.96 corresponds to a confidence level of 0.05, this value was used as the cut-off point. Where pairs of proportions produced a "Z" of less than 1.96, the difference in percentages was considered not significant.

Entries in Table 31 that are not significantly different from the auto mechanic entry in that category are marked with an asterisk. In most cases it will be noticed that the auto mechanic is significantly different from the other occupations and the total male labor force. In the category "singles", for example, auto mechanics are significantly different from all other occupations except painters. The total male labor force has the largest proportion of single men, but there are proportionately more single men in the mechanic occupation than in the other skilled trades; the difference between mechanics and painters is not significant.

4.5.6. EDUCATIONAL BACKGROUND. Table 32 presents the distribution of the years of school completed for automotive mechanics, other selected skilled trades and the total male labor force. When automotive mechanics are compared with the other populations

TABLE 31. MARITAL STATUS OF AUTO MECHANICS, OTHER SKILLED OCCUPATIONS, AND THE TOTAL MALE LABOR FORCE [65]

Occupation	Sample Size*	% Single	% Living With Wife Yes	% Living With Wife No	% Widowed	% Divorced
Automotive Mechanic	35,141	11.5	83.1	2.3	1.0	1.9
Total Male Labor Force	2,285,669	16.7	76.6	2.9	1.6	2.0**
Tool and Die Maker	9,245	6.8	88.3	1.5	1.1**	2.0**
Painter	20,596	12.0**	78.1	4.0	2.2	3.3
Machinist	25,444	8.4	86.0	2.0	1.3	2.1**
Electrician	17,781	7.2	87.4	2.0	1.1**	2.0**
Carpenter	46,068	9.0	84.4	2.6	1.8	2.0**

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*Sample size is based on a survey of 5% of the total population of each occupation.

**Denotes a percentage that is not significantly different from that of auto mechanics in the same category.

TABLE 32. DISTRIBUTION OF THE NUMBER OF YEARS OF SCHOOL COMPLETED [65]

	Elementary School		High School		College		
Occupation	% Under 8	% 8	% 1 to 3	% 4	% 1 to 3	% 4 or More	Median Years Completed
Automotive Mechanic	19.9	21.1	29.7	25.0	3.7	0.4	9.9
Total Male Labor Force	18.2	15.8	22.2	24.4	9.6	9.7	11.1
Tool and Die Maker	8.2	17.5	26.9	38.6	7.8	1.0	11.7
Painter	26.4	23.0	27.2	18.1	4.3	0.9	9.1
Machinist	13.3	19.4	28.6	32.0	5.9	0.7	10.8
Electrician	9.7	14.9	27.2	37.8	9.2	1.1	11.8
Carpenter	25.2	22.6	24.9	22.2	4.2	0.8	9.3

in terms of the median number of years of school completed, it is found that they fall on the low side of the distribution. Mechanics are shown to have more years of school than painters or carpenters, but fewer years of school than machinists, tool and die makers, electricians, or the male labor force as a whole.

Since some of the differences between the medians appear to be slight, a test for statistical significance was made [68] which showed that all of the median years of school completed by the occupations are significantly different (PC ≤ .01) from that of the auto mechanics.

4.5.7. OCCUPATIONAL TRAINING. Bedell found [26] that less than half of the general work force has had formal occupational training. Of those who have, about three-fifths are using it in their present jobs, about one-fifth had used it on a previous job, and about one-fifth have never used it.

A breakdown of formal training programs is shown in Table 33.

TABLE 33. THE DURATION, COMPLETION AND USE OF FORMAL OCCUPATIONAL TRAINING [26]

	Duration of Training (%)			Completion (%)		Use of Training (%)		
Occupation	Less than 6 mo.	6 to 12 mo.	More than 12 mo.	Comp.	Not Comp.	In Use	Prev. Used	Not Used
Total Male Labor Force	20.1	27.2	50.6	77.3	21.0	48.9	24.5	25.8
Carpenter	6.5	22.8	68.9	75.5	23.1	53.4	26.9	18.2
Electrician	14.2	23.6	60.6	75.4	24.2	61.3	22.0	15.3
Painter	11.5	7.7	80.8	80.1	16.0	79.9	15.6	4.5
Machinist	16.1	19.4	61.7	81.4	16.3	58.5	26.6	14.2
Automotive Mechanic	24.0	29.5	44.7	72.8	25.5	35.7	25.5	37.5

It shows the duration of training, the percentage of completion of training, and the extent to which the training is subsequently put to use. Auto mechanics, selected skilled trades, and the portion of the total male labor force that receives formal training are included.

According to these data, formal training programs for auto mechanics are characteristically shorter than the others. The table indicates that, other than painters, fewer trainees complete the formal automotive mechanic training course, and, of those who complete training, the auto mechanics most often fail to pursue the trade for which they were trained.

The study by Bedell [26] shows how many men in the 1963 labor force had previously received formal occupational training in the occupation in which they were then employed. These statistics are based on a survey of 28,000 persons, and, while they show some interesting relationships, they should be interpreted with care. They do not take into account the product of the MDTA occupational training programs, and they are comparatively old; consequently, these data are not representative of the situation as it exists today. A brief summary of these data is provided in Table 34.

Table 35 shows how occupations were learned, and which ways of learning were considered by Bedell's respondents to be most helpful. Note that "all ways of learning" total more than 100 percent since many respondents reported more than one way of learning, and also note that many respondents failed to indicate which way of learning was most helpful. No attempt was made in this survey to evaluate the quality of the training or the opinion of the worker, nor was worker opinion compared with employer opinion.

While these data illustrate some interesting characteristics of the labor force in terms of occupational training, they

TABLE 34. NUMBER OF TRAINING PROGRAMS AND INSTITUTION WHERE TAKEN [26]

	Male Labor Force	Carpenter	Electrician	Painter	Machinist	Auto Mechanic
	Number of Programs (x 1000)					
	24,143	527	968	156	732	1,727
Percent Taken in:						
High School	29.5	23.1	22.6	10.3	21.2	41.6
Junior College	3.8	-	2.2	-	2.3	.6
Tech. Inst.	8.2	.9	13.0	4.5	5.9	4.4
Special School	15.4	9.3	10.5	7.1	14.4	16.0
Apprenticeship	11.7	56.4	24.3	69.7	34.9	6.3
Company School	7.5	1.3	4.6	7.1	6.7	3.4
Armed Forces	16.2	6.1	16.8	1.3	10.7	21.6
Correspondence School	7.7	2.8	6.0	-	3.8	6.1

do not reflect current existing circumstances. Bedell's study could not take into account the effects of the Manpower Development and Training Act, the Vocational Education Act of 1963, and the Economic Opportunity Act of 1964. Programs generated by these acts have influenced, and will continue to influence, the extent, nature, availability, and distribution of vocational and occupational training.

TABLE 35. HOW TRAINING WAS OBTAINED AND MOST HELPFUL WAY OF LEARNING CURRENT JOB [26]

Type of Training	Total Labor Force	Carpenter	Electrician	Painter	Machinist	Auto Mechanic
			ALL WAYS OF LEARNING (%)			
Formal Training	30.2	31.1	72.9	27.8	56.1	40.5
On-the-Job Learning	56.2	48.7	71.2	46.9	70.9	48.1
Casual Method	45.4	67.8	33.4	58.7	36.6	61.9
FORMAL TRAINING			MOST HELPFUL WAYS OF LEARNING (%)			
School	8.7	2.4	10.7	4.5	10.4	8.3
Apprenticeship	2.0	7.0	20.5	12.0	19.7	1.6
Armed Forces	1.2	2.3	4.9	0.5	1.3	4.4
ON-THE-JOB LEARNING						
On-the-job Instruction	29.6	21.9	24.9	22.9	28.8	21.3
Company Courses	3.6	1.2	1.9	0.9	4.7	5.2
Worked Way Up	3.9	2.3	2.2	1.2	2.6	2.1
CASUAL METHOD						
From Friend or Relative	6.0	14.2	1.9	17.2	0.5	10.3
Picked it up	20.4	28.1	6.6	21.5	9.4	27.5
Other	2.5	1.7	1.4	-	1.0	3.0
Not Available	14.6	16.2	24.9	16.5	21.6	14.8

5. FINDINGS: THE TRAINING SYSTEMS

There are three systems for learning the automotive mechanic's trade. The first is through casual exposure to the occupation as a circumstance of employment. The second is through a formal program of instruction where the training is institutionalized, as in high school vocational courses, or MDTA skill centers. The third is a work-oriented combination of the first two, which, in its most advanced form, becomes formal apprenticeship training. On-the-job training (OJT) is a variation of apprenticeship; it is less rigorous, narrower in scope, and customarily of much shorter duration. The manufacturers' training course is another variation of apprenticeship which, in general, embraces a single topic or subject matter and lasts only a few days.

5.1. THE NON-SYSTEM

The most common way of learning the automotive mechanic's trade is the acquisition of skills and knowledge through work experience. This kind of learning is the least formal and the least systematized, and it is called training only by a loose interpretation of the word. One who becomes a mechanic by this method typically starts as a helper and works his way up for an indefinite period of time to some unidentified level of competency at which he becomes known as a mechanic. This study attaches the name "non-system" to this process.

Snow's survey [10] indicated that about 19 percent of all auto mechanics enter the trade without previous training, and that an additional eight percent had learned by "hanging around repair shops" and "working on the family car." The Occupational Outlook Handbook [35] states, however, that "most automobile mechanics learn the trade through on-the-job experience," and Snow acknowledges that his estimate may be in error because of the large number of respondents who checked more than one answer.

The results of Snow's survey are shown in Table 36.

TABLE 36. INITIAL TRAINING SOURCE FOR AUTO MECHANICS (176 SURVEY RESPONDENTS) [10]

Source	Total Mechanic Responses*	Percent of Total Responses**
Trade School	63	33
Formal Apprenticeship Program	60	31
Armed Forces	6	3
High School	12	6
On the Job without Previous Training	41	19
Other	14	8
Totals	196	100

* Total responses are greater than 176 because some respondents gave more than one answer.

** Percentages are given in terms of all responses.

Bedell's survey [26] was based on a much larger sample than Snow's, and the resulting statistics are in general agreement with the findings in the literature. Bedell reports that 61.9 percent of the mechanics acquired their mastery of the trade through the casual methods of learning, and 48.1 percent obtained their training through on-the-job learning. Table 37 explains these terms in detail. Note that the category of on-the-job learning could, by definition, include many respondents whose training was essentially non-system.

While it is possible for the mechanic to by-pass all contact with the formal training systems, it is not possible to escape the non-system. Consequently the non-system is viewed as an important but largely uncontrollable aspect of the overall training process. Bedell found that 40.8 percent of automotive mechanics indicated that the casual methods were the most helpful ways to learn their trade; 28.6 percent favored on-the-job

TABLE 37. ALL WAYS OF LEARNING AUTOMOTIVE MECHANIC OCCUPATION [26]

Method of Learning	Percent Distribution[1]
Formal Training[2]	40.5
On-the-job Learning[3]	48.1
Casual Methods[4]	61.9
Not Available	1.0

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[1] Percent distribution of civilian workers 22 to 64 years old who completed less than 3 years of college; percentages total more than 100 percent because of multiple responses.

[2] Includes school (company training school only if training was full-time for at least 6 weeks), apprenticeship, and Armed Forces.

[3] Includes on-the- ob instruction by supervisors or fellow workers, company training courses (part-time, or full-time less than 6 weeks), and worked way up by promotion.

[4] Includes "learned from friend or relative," "just picked it up," and other methods.

learning; and 14.3 percent chose formal training. Thus, almost 70 percent of the mechanics indicated a preference for informal training, which may be roughly equated to the non-system process. The distribution of responses to "most helpful way" is shown in Table 38.

5.2. THE INSTITUTIONALIZED SYSTEM

The institutionalized system is the aggregate of the education and training institutions in which programs of formal occupational instruction are available to eligible members of the general public. Eligibility is controlled by the institution rather than by an employer, and an employed status is not, in general, a prerequisite to enrollment. The basic purpose of the institutionalized system is to provide the young, the inexperienced, and the untrained with at least entry-level skill

TABLE 38. MOST HELPFUL WAYS OF LEARNING AUTO MECHANIC'S TRADE [26]

Way of Learning	Distribution in Percent	
Formal Training		14.3
School	8.3	
Apprenticeship	1.6	
Armed Forces	4.4	
On-the-job Training		28.6
On-the-job Instruction	21.3	
Company Training Courses	5.2	
Worked Way Up	2.1	
Casual Methods		40.8
From Friend or Relative	10.3	
Picked It Up	27.5	
Other	3.0	
Not Available		14.8

in a specific, selected occupation. Advanced courses, recurrent training, and up-grading programs are customary and legitimate secondary goals of the system. The system includes the public schools, the post-secondary schools, the adult education programs, the MDTA institutional training centers and the commercial trade schools.

5.2.1. THE PUBLIC SCHOOL VOCATIONAL TRAINING PROGRAMS. The public schools offer two kinds of occupationally oriented programs: those that are an extension of the general education process, and those that are intended to prepare the youth for employment in a selected occupation. Programs that simply provide the student with an overview of the world of work, or an introductory experience in a given occupational area, are usually classified as industrial arts. Programs that are intended to equip the student with at least the minimum knowledge and skills required for entry-level employment in a specific trade or occupation are classified as vocational.

Although industrial arts programs can provide a practical introduction to an occupation, the literature indicates that they are not ordinarily directed to that end. These programs are usually designed for the lower grades, i.e., junior high school, and they are frequently the only occupationally oriented courses available in a school. Where vocational training courses in trade and industrial subjects are offered, however, they are, for the most part, taught only in the last two years of high school. Thus, students who do not enter high school, or who fail to complete it, are regularly denied the in-school opportunity to acquire a salable vocational skill.

While the industrial arts courses constitute an important back-up for the vocational educational system, this study is concerned with programs that are specifically designed to train automotive mechanics. Consequently, the junior high school and industrial arts courses have been deleted from the study, and data collection has been restricted to the high school vocational training programs for automotive mechanics.

Job Market Orientation. Generally, the high school auto mechanic course is designed around the standard American automobile, and these courses are supposed to equip the student with the fundamental skills and knowledge required in the routine service, maintenance and repair of automobiles. Although specialized courses, such as engine tune-up, front-end repair, air conditioning, or auto electronics are available in many schools, the major emphasis is on developing an all-around mechanic. Yet, even though the primary intention is to prepare the student for a successful career, there is no assurance that he will be accepted into the industry as a mechanic or that he will choose to pursue the mechanic trade upon graduation.

The job market itself is composed of two general classes of jobs: those in which the graduate is employed as an auto mechanic, and those in which the graduate is employed in the industry, but in some capacity other than auto mechanic. When a job opening occurs, the employer must decide whether to consider it an entry level vacancy and what the prerequisites for employment should be. He must also decide whether or not recent graduates of high school auto mechanic courses are eligible for the position. The industry in general assigns mechanic jobs on the basis of experience rather than training, where the training is of the high school pre-employment type. Consequently, the schools are training at above entry level as established by the industry, but at below entry level in terms of the industry-wide standard of mechanic competency and experience.

Since the new automobile dealership garages have traditionally paid the highest salaries, they have become a primary job target for auto mechanics. However, it is seldom possible to step from the classroom into such a position, since mechanic jobs are not readily available to entry level people. The independent automotive repair shop and other employers of auto mechanics also compete for skilled workmen. Like dealerships, however, they are reluctant to accept the new graduate as a fully qualified mechanic.

It is customary to start the auto mechanic graduate in a position of lesser responsibility, such as helper or greaser. In this way, the new mechanic can broaden his experience while he is acquiring the needed maturity. Consequently, many related occupations, such as gasoline service station attendant or parts counter man, are recognized as legitimate areas of the job market. Thus, it would be entirely correct to say that the job market toward which the high school programs are oriented encompass all aspects of automotive service and repair work, including the gasoline service station, the independent shops and specialty houses, automotive parts places, and the automobile dealership garages.

Labor Force Involved. There are two general categories of workers who depend upon the formal training process for an improved employment opportunity: those who are preparing for entry level employment, and those who seek upgrading. In the case of the public secondary school, the emphasis is on preparation for employment; upgrading programs are offered in the high school, but mostly in the form of night school adult education courses.

Most high school job preparation programs consist of in-school, pre-employment, vocational education courses. Cooperative on-the-job training programs (work-study programs) account for an increasing proportion of high school training programs. Academic classes related to apprenticeship training programs are also conducted in high schools.

The most extensive full-time in-school programs, however, are those concerned with secondary school pre-employment training, while the adult education classes touch the largest number of people (in the trade and industrial category). A general report of the Advisory Council on Vocational Education [27] details the extent of participation in the various training programs (except MDTA). This information is given in Table 39. Note that auto mechanics are a sub-group of the trade and industrial category; this source indicates that 7.7 percent of these (98,377) are auto mechanic students, and 1.0 percent (12,912) are auto body and fender trainees. No breakdown of auto mechanics is given according to program type, i.e., secondary, post-secondary, adult education, or special needs.

Sponsorship and Financial Support. While numerous automotive manufacturers and suppliers encourage auto mechanic training in

TABLE 39. DISTRIBUTION OF OCCUPATIONAL TRAINING PROGRAMS ACCORDING TO OCCUPATION AND LEVEL OF CONTROL [27]

Educational Category	Total	Secondary		Post-Secondary		Adult		Special Needs	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Agricultural	907,354	510,279	56.2	5,987	0.7	390,388	43.0	700	0.1
Distributive	420,426	101,728	24.2	15,833	3.8	301,116	71.6	1,749	0.4
Health Occupations	83,677	9,793	11.7	36,496	43.6	37,065	44.3	323	0.4
Home Economics	1,897,670	1,280,254	67.5	2,652	0.1	602,363	31.7	12,401	0.6
Office Occupations	1,238,043	798,368	64.5	165,439	13.4	271,149	21.9	3,087	0.2
Technical	253,838	28,865	11.1	100,151	39.5	124,733	49.1	92	0.4
Trade and Industrial	1,269,051	318,961	25.1	115,539	9.1	803,901	63.3	30,650	2.4

the high schools through donations of equipment, scholarships, competitions, and other contributions, the main sources of sponsorship for vocational education are the various agencies and branches of the federal, state and local government. An additional important source of support is the business and professional associations such as the National Automobile Dealers Association, Automobile Manufacturers Association, and the American Vocational Association, and the affiliated industries such as petroleum and insurance.

The funding of auto mechanic training is reported only in general terms in this study, since a cost/benefit analysis was not performed. The report of the Advisory Council on Vocational Education is based on fiscal 1966 data and shows the total federal, state and local expenditures for vocational education and for overall trade and industrial, but does not detail the cost of automotive mechanic training. The cost of auto mechanic training was computed, therefore, as follows.

The ratio of the cost of trade and industrial training to the total cost of vocational education was found by dividing the cost per trade and industrial pupil with the cost per pupil of vocational education. These figures are derived from data given in the report. Applying this ratio (found to be 2.68) to the cost of vocational education per pupil for each level of training then produces the per pupil cost for each level of training for trade and industrial enrollments.

Since the Advisory Council report makes no distinction between the cost of trade and industrial training and auto mechanic training, this study assumes that the costs are the same. Although the data indicate that 7.7 percent of the enrollments (98,377) are auto mechanic students, the distribution at the different levels of training is not given. Consequently, the percentages derived from an unpublished report by Harold Duis

[71] are used to provide an estimated distribution, shown in Table 40. Duis' treatment of these statistics is included in Appendix C.

TABLE 40. ENROLLMENTS AND EXPENDITURES FOR AUTO MECHANIC TRAINING, FISCAL YEAR 1966

	Secondary	Post Secondary	Adult	Special Needs	Total
Expenditure/ Pupil	179.16	535.52	35.96	276.49	146.20
% of Total* Enrollment	52.9	15.1	29.6	2.1	99.7
Enrollments	52,041	14,855	29,120	2,066	98,377**
Estimated Expenditures	9,323,743	7,955,111	1,047,141	571,205	18,897,200

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*From reference 71.
**From reference 27.

It is recognized that the figures in Table 40 may be considerably in error, since they are based on assumptions rather than facts. The report of the Advisory Council acknowledges that:

> The reporting system presents severe limitations to any type of analysis that can be made. It does not provide enrollments and expenditures for the different levels of instruction. Further, in reporting by broad occupational programs, there is no way to determine variations of specific programs within the occupational fields.

Consequently, these figures are both inexact and inaccurate, and are intended only to provide a gross measurement of the cost of the public, in-school, auto mechanic, training effort.

The 1968 Digest of Educational Statistics [68] shows the dollar amount of grants and loans for education that are administered by each department of the Federal government, including those administered by the Office of Education. In addition, it lists all of the federal acts, such as George Barden, Smith-Hughes, Vocational Education Act of 1963, the Manpower Development and Training Act and others, all of which provide funds for vocational training. While this source indicates that over 439 million dollars was obligated by the Federal government for vocational education in 1968, it does not indicate what proportion of that amount was allocated to automotive mechanic training.

Another important financial aspect of vocational training has to do with the earnings of the student. Where the training is conducted full time in the high school, incidental student earnings are not ordinarily viewed as being essential to the educational process. While such part-time jobs are generally considered to be beneficial, they are frequently suspected of being a potential threat to satisfactory completion of the program.

In the case of the cooperative education program, however, where the work-study principal is used, student employment is an integral, planned dimension of the overall learning process, and is considered to exert an important influence on the attitude, behavior and progress of the student. Since the student is, in fact, employed by a businessman who cooperates with the school (by providing a job and on-the-job training), the salary becomes highly important as a symbol of success and as an incentive to continue the program. While co-op students normally work about half time, and are normally paid an entry-level wage, they generally respond favorably to the system, and generally are more inclined to stick with the trade than students who receive their training in the full time, high school, vocational program.

Enrollments, Completions and Job Placements. The Advisory Council on Vocational Education presented the fiscal year 1966 enrollment data in terms of the different levels of vocational education [27]: i.e., secondary, post-secondary, adult education, and special needs. The percentage of the total vocational enrollment is reported for each of these categories, but the data are listed according to the major vocational education classifications: for example, agriculture, home economics, distributive, technical education, trade and industrial, etc. The enrollments in specific occupations, such as carpenter, plumber, electrician, machinist, or auto mechanic, are not detailed but are shown as a percentage of, in this case, the trade and industrial classification. Thus the data do not show how many auto mechanic trainees there are, but what percent of the trade and industrial students are learning to be auto mechanics.

While the number of trade and industrial students in each level is given, it is not possible to be sure how many automotive students there are in each level, since there is no indication that the distribution of automotive students is the same as the distribution of the total trade and industrial population. According to this reference, there are 1,269,051 students in trade and industrial programs, and 7.7 percent of these, or 98,377, are in automotive mechanic training courses. Using the distribution figures for level of education, 25.1 percent of the mechanic trainees (24,693) are in secondary, 9.1 percent (8,952) are in post-secondary, 63.3 percent (62,273) are in adult education, and 2.4 percent (2,361) are in special needs. The figure for enrollment at the secondary level is low according to information derived from other sources.

In Subject Offerings and Enrollments in Public Secondary Schools [28], data from a survey of the 1960-61 school year are used. In this case the number of schools offering specific subjects are reported, as well as the total enrollments in those subjects. This source indicated that auto mechanics accounted for 16 percent of the trade and industrial enrollees. Data are given for both industrial arts and vocational education (for grades 9-12) and are listed as follows:

Power and Auto Mechanics (Industrial Arts)	
Number of Schools Offering	779
Enrollments	
Half Year	16,435
Full Year	37,851
Automotive Mechanics (Vocational)	
Number of Schools Offering	1,293
Enrollments	
Half Year	4,544
Full Year	50,015

This source does not indicate how many of the schools offering an industrial arts automotive course are the same schools as those offering vocational auto mechanic courses. Nor is there any indication of how many of the auto mechanic students may have previously taken an industrial arts auto mechanic course. The report shows that there were 54,599 students enrolled in vocational auto mechanic courses and 54,286 students enrolled in nonvocational automotive courses during the school year in which the survey was made. On this basis, the total number of in-school youths with some pre-employment exposure to the auto mechanic's trade was 108,845. These figures do not include the 11,196 students enrolled in auto body mechanics courses.

The U.S. Office of Education now requires each state to file an annual report of all federally assisted public school vocational programs. The data are reported in accordance with a numerical system described in Vocational Education and Occupations, 1969 [69]. This system, which identifies, defines and classifies vocational and technical instruction programs, and links them to a wide range of occupations, was developed through the joint efforts of the Division of Vocational and Technical Education, Bureau of Adult, Vocational and Library Programs, U.S. Office of Education, and the Branch of Occupational Analysis, U.S. Training and Employment Service, Manpower Administration. The system is basically a cross reference of the training courses identified and described by the U.S. Office of Education in Standard Terminology for Curriculum and Instruction in Local and State School Systems, 1969 [70], and the occupations identified and described by the Bureau of Labor Statistics in the Dictionary of Occupational Titles [8]. Since it is designed for computerization, this system will greatly improve the statistical analysis and follow-up capability of the U.S. Office of Education once it is fully implemented.

The training course classification system identifies seven major vocational-technical areas, and codes them as follows:

> 01. Agricultural, 04. Distributive Education, 0.7, Health Occupations Education, 09. Home Economics, 14. Office Occupations, 16. Technical Education, and 17. Trade and Industrial Education.

A second 2-digit position indicates the principal segment of the subject matter, and a third 2-digit position shows the specific division of that segment. In some cases a fourth 2-digit position is used to identify first level detail. Accordingly, the automotive related training courses are identified and correlated with occupations as follows:

USOE Classification	DOT Classification	
17.0300 Automotive Services	379.384-010	Automobile Tester
	620.281-038	Bus Inspector
	620.884-054	Used-Car Renovator
	806.381-034	New-Car Get-Ready Man
17.0301 Body and Fender	807.287-010	Shop Estimator
	807.381-010	Auto-Body Repairman
	807.381-022	Body Repairman, Bus
	807.884-030	Floor Service Man, Spring
	845.781-018	Painter, Automobile

17.0302 Mechanics	620.281-014	Automobile Mechanic
	620.281-018	Automobile Tester
	620.381-014	Auto.-Service Mechanic
	620.884-010	Auto.-Mechanic, Helper
17.0303 Specialization, Other	620.281-034	Brake Man, Automobile
	620.281-042	Carburetor Man
	620.281-062	Front-End Man
	620.281-098	Transmission Mechanic
	620.281-106	Tune-Up Man
	620.381-010	Auto.-Radiator Man
	(Etc. 9	additional titles)
17.0399 Automotive Services, Other	No Specific Listed	DOT Classification

The following data were taken from an unpublished summary of the FY 1968 enrollments [71] by Harold Duis a condensed version of which appears in Appendix C.

			Enrollments			
Category	Secondary	Post Secondary	Adult Prep.	Education Supp.	Special Needs	Total
17.0300	16,251	452	920	1,550	827	20,000
17.0301	9,716	3,682	1,486	2,901	736	18,521
17.0302	61,821	17,490	7,803	26,661	2,705	116,480
17.0303	1,004	151	837	8,140	92	10,224
17.0399	2,814	279	56	611	232	3,992

The Duis report [71] also provides data on estimated completions and placements for the secondary and post-secondary programs; completions for adult programs are not recorded because these people are already in the labor force. For all trade and industrial programs the percent placement (in the trade or related field) is 74.1 percent of those available for placement; i.e., 69.2 percent for secondary, and 88.0 percent for post-secondary. The data indicate that 56.9 percent of the secondary program completions and 64.8 percent of the post-secondary completions are available for placement; the remaining 43.1 percent and 35.2 percent go into the armed service, continue full-time study, or are not available for other reasons. Although these percentages apply to the entire category of trade and industrial, it is assumed that similar figures would apply to the automotive programs. On that basis, the following numbers of 1968 completions may be expected to be employed full time in the field trained or a related field:

Program	Secondary and Post-Secondary Completions	Est. Employed in Field Trained
17.0300 Service	3,947	2,925
17.0301 Body and Fender	4,116	3,050
17.0302 Mechanic	26,570	19,688
17.0303 Specialization	542	402
17.0399 Other	1,347	998

According to these data, 22,421 (36.2%) of the secondary school students completed training, and 4,103 (23.4%) of the post-secondary students completed. It is not possible to tell, however, on the basis of available information, how many new enrollments and how many dropouts occur each year. Thus, it must be stated that 61,821 enrollments are required annually to produce 22,421 secondary school completions annually, and that unknown proportions of the enrollments will be new students, second year students, and third year students. The same assumption applies to the 17,490 post-secondary students.

Note that while these enrollment figures are in general agreement with the 1960-61 data [28], they are substantially different from those reported by the Advisory Council [27], except for the special needs category. The 1968 data [71] also provide a breakdown of the adult education programs, showing that the perponderance of the adult training is in the area of supplemental (upgrading) rather than preparatory (pre-employment) training.

The U.S. Office of Education requested follow-up data on students enrolled in fiscal 1966, and the resulting sample consisted of 606,872 vocational and technical students. According to the Advisory Council [27], 23.5 percent (142,466) of these were trade and industrial students. There is no indication, however, of how many or what percentage of the trade and industrial sample were automotive mechanic trainees, hence it is not possible to tell from these data how many automotive students completed the program requirements. While the Advisory Council shows that 7.7 percent of the trade and industrial enrollments are automotive mechanics, it would be incorrect to assume that 7.7 percent of the trade and industrial completers (10,969.8) are automotive mechanics.

Kaufman [40] did not report completion rates, but showed enrollments for the current year, and graduations for the previous year. Although graduations in every case were lower than twelfth grade enrollments, there is no evidence that the difference indicated a failure to complete the program. Kaufman found, however, that 67.2 percent of the trade and industrial graduates were placed in the occupation for which they were trained or in a related occupation; 14.2 percent were in the armed forces; 7.6 percent were in unrelated occupations; and the remaining 11.9 percent were in higher education, unemployed, or unaccounted for. These percentages apply to the entire vocational category of trade and industrial, and it cannot be assumed that the distribution will be identical for each individual occupation, such as automotive mechanics.

The Follow-Up Study of 1963 Graduates of Trade and Industrial Programs in Public Vocational and Technical High Schools [72] presents completion and placement data on 1963 graduates in the twelve North Atlantic states and the District of Columbia.

Data for all of the occupational courses taught in the region were collected and published annually for a number of years in this longitudinal study. Following publication of the 1963 data, however, the program was discontinued, and no comparable study has appeared since then.

Table 41 presents the data on full-time and part-time auto mechanic students who graduated in 1963 in the North Atlantic Region [72]. While it is acknowledge that these data are old, and consequently of questionable applicability, they are included because they constitute a sizable body of placement information concerning the population under study. Of the full-time students, 72.8 percent were available for employment, and 67.6 percent of that number were employed in the trade or in a related occupation. Of the co-op students, 79.0 percent were available for employment, and 94.5 percent of that number were in the trade or a related occupation. Military service and continuing education accounted for the majority of those who were not available for employment. Caution should be observed in evaluating the significance of employment in related occupations; the relatedness of an occupation is loosely defined and is not controlled by any standardized system of identification.

While the most effective management of the training establishment depends in some degree upon the availability of current and accurate completion and placement data, a dearth of such information exists at this time. Data of this sort are usually obtained through follow-up activity, and, while local efforts are relatively common, studies on a larger scale are virtually non-existent. The Advisory Council recognizes this: "There is a general lack of national data on placement and follow-up, and an absence of any system for reporting these data in detail" [27]. Consequently, the follow-up information presented in this study must be interpreted with care.

TABLE 41. PLACEMENT OF AUTOMOTIVE MECHANIC STUDENTS GRADUATED FROM PUBLIC SCHOOLS IN 1963, NORTH ATLANTIC REGION [72]

Employment	Graduates	Not Available For Employment	Available For Employment	In Jobs Related To Training	In Jobs Not Related To Training	Unemployed And Unaccounted For
Automotive Mechanics (all day)	2843 (100%)	772 (27.1%)	2071 (72.8%)	1401 (67.6%)*	423 (20.4%)*	247 (11.9%)*
Automotive Mechanics (part-time cooperative)	277 (100%)	58 (20.9%)	219 (79.0%)	207 (94.5%)*	10 (4.5%)*	2 (0.9%)*

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*Percent of those available for employment

Training Courses: Content and Duration. Obviously, there are many factors involved in an effective training program. However, the limitations of time and funding did not permit the investigators to examine them all. Consequently, this study assumed that a satisfactory evaluation of vocational automotive mechanic training courses can be made through a systematic comparison of the specific course content and hours of instruction with those of a training course of known high quality. To that end, it was necessary to determine the range of course offerings and to identify a suitable standard automotive mechanic training course.

In order to establish the range of course offerings, auto mechanic training course outlines were solicited from high schools in Michigan, Illinois, Pennsylvania, California, Ohio, New York, New Jersey and Texas. These states were selected because their combined motor vehicle population constitutes approximately half of the total vehicle population of the United States, and, in addition, they include all types of motor vehicle safety inspections currently in use. While approximately 80 course outlines were obtained, only 40 were used in this study; some were more nearly industrial arts than vocational; others did not provide an adequate breakdown of subject matter or hours of instruction; a few were in a format that made comparison difficult.

The automotive mechanic training course outlines identified as standard were selected upon the advice of many recognized authorities on the subject of auto mechanic training. Some of those who contributed greatly in that effort are listed below:

Mary P. Allen	Director of Public Information, American Vocational Association
William Berndt	Senior Program Officer, Curriculum and Instructional Materials, Division of Vocational and Technical Education, U.S. Office of Education

R.A. Bollman	Manager, Service Training Product Service, Chrysler Motors Corporation
A.A. Hansen	Consultant, Trade and Industrial Education, Department of Education, State of Michigan
R.J. Liable	Manager, Service Training Department, Wixom Assembly Plant, Ford Motor Company
Dr. Robert C. Lusk	Director, Educational Services, Automobile Manufacturers Association
Paul E. McDonald	National Manager, General Motors Training Centers, General Motors Corp.
Arthur J. Oettmeier	Dean of Technical Education, Delta College, Bay City, Michigan
Carl H. Turnquist	Divisional Director, Vocational Education, Department of Vocational Education, Detroit Public Schools
Mel Turner	Curriculum Director, Automotive Services Industry Association, Chicago, Illinois
Ralph Wenrich	Professor of Vocational and Technical Education, University of Michigan

As previously indicated, the course outlines obtained from the high schools varied considerably in the manner in which the information was presented. Thus, it was necessary to arrive at a standardized format for cataloging the different subject matter areas and for recording the hours of instruction devoted to each. Consequently, the subject matter was divided into the nine major subsystems of the vehicle and three categories of miscellaneous instructions. Table 42 shows the major subject matter divisions and lists the specific items that may be found under each.

The contents and hours of each course outline were then assigned to the appropriate section. This made it possible to compare the course content and hours of instruction of all course outlines used. Since it was also possible to detail the standard course outlines in the same manner, it was then a simple matter to compare each outline to the standard. Table 43 lists all of the high school course outlines used and shows the

TABLE 42. SUBJECT MATTER DIVISIONS AND SPECIFIC ITEMS UNDER EACH

1. Engines
   - Head, cylinder block
   - Valves, valve mechanisms
   - Piston, connecting rod assembly
   - Crankshaft and bearings
   - Lubricating systems, oil pump and filter
   - Cooling systems
   - Exhaust systems
   - Crankcase ventilation systems

2. Fuel Systems
   - Carburetors
   - Fuel pumps
   - Intake manifolds

3. Electrical
   - Basic electricity
   - Battery
   - Diagnosis of electrical malfunctions
   - Windshield wiper and washer
   - Seat and window controls
   - Starter system
   - Ignition system
   - Charging system, A.C.,D.C.
   - Lighting and warning systems
   - Accessories and instruments

4. Suspension
   - Steering: conventional, power
   - Front (including wheel alignment)
   - Rear
   - Wheels and wheel balance
   - Chassis lubrication

5. Braking Systems
   - Conventional (including disc)
   - Power (including disc)

6. Drive Line
   - U-joints
   - Propeller shaft

7. Transmission
   - Conventional (including clutches)
   - Overdrive
   - Automatic

8. Differential
   - Convential
   - Limited slip

9. Ventilation System
   - Heater
   - Air Conditioner

10. Body Service
   - Doors, hood and trunk
   - Window mechanism
   - Convertible tops
   - Glass and trim

11. Tools
   - Hand tools
   - Power tools
   - Arc welding
   - Acetylene welding

12. Miscellaneous
   - Safety
   - State inspection systems
   - Shopwork
   - Orientation
   - Tests, etc.

TABLE 43. HIGH SCHOOL VOCATIONAL AUTOMOTIVE MECHANIC TRAINING COURSE OUTLINES: SUBJECT MATTER AND HOURS OF INSTRUCTION

School	Engines	Fuel System	Electrical System	Suspension System	Braking System	Drive Line	Transmissions	Differentials and Rear Axles	Ventilation System	Body Services	Tools and Welding	Misc.	Reported Total Course Hours
1	180	30	165	135	45	120	30				15	90	810
2*	205	100	345	165	60	18	190	18		15	15	105	1258
3	300	180	100	100		300						100	1080
4	405	105	210	75	45	15	105	60				60	1080
5*	135	75	75	90		75						90	480
6	440	100		240	80		120	120		40	120	150	1620
7*	369	75	225	135	45		105	60		12		84	1143
8	81	48	162	43	38	6	100	27	11	27			543
9	328	125	360	137	115		165	65		5	135		1435
10*	1325	583	884	325	700		300	500			283	1100	8000
11	242	117	263	302	47	42	386	41			50	130	1620
12	433	234	343	168	130	60	60	30			2		1460
13*	280	235	355	210	130	15	150	35			120	60	1620
14*	180	180	180	300			150					90	1080
15	430	120	340	130	60		60				120	180	1440
16	360	120	180	180	120	30	150	30		60	60	240	1530
17	34	11	19	15	8		19	8			11	11	136
18	500	120	600	230	100		300	120				30	2000
19	180		180	180	90		90	90				210	1020
20*	600	100	400	100	100		200		30		30	30	1620
21*	522	60	137	102	60	87	30					93	1620
22*	520	30	30	40	70		115	10			30	20	1125
23	130	124	173	95	60		50	40				48	720
24*	230	140	116	96	40		120	16				43	1001
25	66	24	90	96	36	15	75	24	12		15	90	543
26*	245	70	110	100	45		400	30			60	20	1340
27	170	30	40	50	10		40	10				10	360
28	160	70	70	56	50		84	27		17		6	540
29	40	20	25	10	15		30	25			5	10	180
30	381	197	77	138	99		118		10		17	154	1191
31*	341	335	350	181	70	17	391	22	74		23	10	1740
32	450	180	180	360	225		225						1620
33	300	60	180	180	60	30	120	30		120	60	60	1200
34	59	51	53	66	32	4	12	8				10	295
35	60	12	24	16	6	3	21	9				14	165
36	674	80	280	175	160		96	50		40	40		1595
37	100	50	50	20		30	60	40				10	360
38	270	135	270	247	45	35	65	35				22	1124
39	527	67	270	135	67	43	157	43		14		27	1350
40	315	105	165	60	90	45	165	45				60	1050

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*The sum of the detail for these courses does not equal the reported total course hours.

breakdown of subject matter and hours of instruction.

because of differences in terminology and the variety of combinations of items in a specific course unit, it was not always possible to tell to which subsystem an item belonged, or to determine precisely how much instruction time it merited. For example, some outlines included the windshield wiper system with the electrical, and some listed it with body services; others ignored it altogether. Some outlines allotted time to testing, indoctrination, orientation, etc., and some did not. In other cases there was a discrepancy between hours shown for the parts and hours shown for the total.

In any case, it is concluded that the breakdown, as given in Table 43, is sufficiently accurate for the purpose intended, i.e., to see how the course compares with the standard. It will be noted that variation in course outlines is great, both as to content and length. Course length varies from 136 hours, with very limited course content, to 8000 hours, which, apparently, is an apprenticeship program conducted in conjunction with the public school. It is found that many schools exceed the requirements established by the standard, particularly in the area of engines, while many fall short of the standard, particularly in the area of electrical systems.

In selecting a standard, three courses were chosen; one was generated by the Automobile Manufacturers Association in conjunction with the Industry Planning Council of the American Vocational Association; two were produced under the auspices of the U.S. Department of Health, Education and Welfare. Each of these standards emphasizes a different aspect of the automotive service and repair industry. Consequently each concentrates on different subject matter areas, with hours of instruction adjusted accordingly.

A publication of the Automobile Manufacturers Association [73] includes descriptions and illustrations of appropriate paperwork, shop lay-out, tool and equipment lists, expendable supply list, and extensive information on the facility requirements for a variety of school sizes. In terms of course content and hours of instruction, the Automobile Manufacturers Association tends to minimize the engine and emphasize the electrical and the transmission. The recommended length of their course is 1080 hours; this is considered the minimum amount of training that will permit the graduate to enter the field as a trainee with a uniform degree of competence in each of the course units. Where it is necessary to reduce the length of the course in order to accomodate other secondary curricula, it is recommended that each unit be reduced proportionately, rather than by shortening or eliminating one or more units. The course is restricted to the vehicle itself and does not provide for such matters as housekeeping and customer relations, although it recommends specific academic courses such as English, Social Studies, Science, Mathematics, etc. The course is intended to provide a comprehensive knowledge of automobiles to the individual who plans to enter the trade as a beginner and become a first-class mechanic through continued experience and training.

The second course was developed by the U.S. Office of Education [74]. Although it was intended primarily for use by the Manpower Development and Training Program, it is well suited to secondary school use, with some adjustment of recommended times. The program was designed to cover a period of 252 days and includes 1764 hours of classroom instruction and closely supervised shop practice. Where the course is intended for high school use, it will be necessary to stretch the overall time period to two years minimum, since the course was originally planned to progress at a rate of seven hours a day, five days a week. This program is more intensive than the first, and it is intended to help the trainee develop and advance beyond the basic skill requirement for job application. Much of the related material included in the outline has been added specifically to assist the trainee to progress beyond the entry-level classification.

The third course selected as a standard was also developed by the U.S. Office of Education [75]. This guide was also basically designed for use in the Manpower Development and Training Program. In this case, however, the intended recipient is not expected to graduate into a position as a fully qualified mechanic, but is seen as entering the industry as a competent gasoline service station operative capable of making minor repairs and adjustments to the automobile. The course is basically set up to be executed in three 12-week sections, requiring seven hours a day, five days a week for a total of 36 weeks. This course, as might be suspected, devotes relatively less time to the engine, transmission, and electrical system and concentrates more on fuel systems, suspension, and brakes. In addition, the related instructions are oriented more toward appearance, housekeeping, and customer relations. As with the second course, it will be necessary to make adjustments to this one in order to achieve a satisfactory fit with the other curricular requirements of a high school.

Table 44 presents all three standard courses in outline form so that course content and hours of instruction may be compared directly. It will be noted that since the last two outlines are basically MDTA courses, a good deal more shop and/or laboratory time is planned into the schedule. This reflects the seven hour a day block time arrangement that is possible with MDTA, where other curricular activities need not be considered. In any event, it is concluded that these three courses provide standards that are sufficiently flexible to accomodate the job market orientation of the majority of the secondary

TABLE 44. COURSE CONTENT AND HOURS OF INSTRUCTION FOR SUBENTRY LEVEL, ENTRY LEVEL, AND QUALIFIED AUTOMOTIVE MECHANICS

	A[73]** 162[1]	B[74]** 52[1]/200[2]	C[75]** 6[1]/5[2]/60[3]
Engines			
Head, Cylinder Block	x	x	
Valves and Valve Mechanisms	x	x	
Pistons and Connecting Rod Assembly	x	x	
Crankshaft and Bearings	x	x	
Lubrication Systems, Oil Pump and Filter	x	x	
Cooling Systems	x		x
Exhaust Systems	x		x
Crankcase Ventilation Systems	x		
Principles of Engine Operation		x	
Proper Inspecting Procedures		x	
Mechanical Indications and Conditions			x
*Total	162	252	71
Fuel Systems	97	21/112	18/36/85
Carburetors	x	x	x
Fuel Pumps	x	x	x
Intake Manifolds	x		
Fuel System Testing			x
Operation of Component Parts		x	
Symptoms of Inefficient System		x	
Servicing Procedures		x	
*Total	97	133	139
Electrical Systems	324	61/170	53/65/107
Basic Electricity	x	x	x
Battery	x	x	x
Diagnosis of Electrical Circuit Malfunctions	x		
Electric Windshield Wiper and Washer Systems	x	x	x
Electric Seats and Windows	x		x
Starter Systems	x	x	x
Ignition Systems	x	x	x
Charging System - A.C., D.C.	x	x	x
Lighting and Warning Systems	x	x	x
Accessory and Instrumentation Systems	x	x	x
*Total	324	231	225

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[1] Total; [2] Laboratory and Shop; [3] Shop

TABLE 44. COURSE CONTENT AND HOURS OF INSTRUCTION FOR SUBENTRY LEVEL, ENTRY LEVEL, AND QUALIFIED AUTOMOTIVE MECHANICS (CONTINUED)

Suspension System	86	34/155	29/48/217
Steering--Conventional, Power	x	x	x
Front Suspension (including wheel alignment)	x	x	x
Rear	x	x	x
Chassis Lubrication	x		x
History and Evolution of Suspension Systems		x	x
Maintenance of Suspension and Steering System		x	x
Corrective Procedures for Suspension and Steering System Troubles		x	x
Diagnose Suspension System Problems			x
Wheels and Tires (including wheel balance)	x		x
Wheel Balance (does not include tire service)		x	
*Total	86	189	294

Braking Systems	76	24/100	19/37/168
Conventional (including disc)	x		
Power (including disc)	x		
Evolution of Brake Operating Systems		x	x
Braking Principles		x	x
Components of Brake Systems		x	
The Hydraulic Brake (including components of brake system)			x
Diagnose Brake Problems			x
Service Brake System			x
Minor Brake Adjustment Procedures			x
*Total	76	124	224

Drive Line	11
Universal Joints	x
Propeller Shaft	x
*Total	11

TABLE 44. COURSE CONTENT AND HOURS OF INSTRUCTION FOR SUBENTRY LEVEL, ENTRY LEVEL, AND QUALIFIED AUTOMOTIVE MECHANICS (CONTINUED)

Differential and Rear Axle	54	14/100	
Description and Functions of Differential		x	
Types of Differential (conventional, limited slip)	x	x	
Lubrication and Service of Differential		x	
Description and Function of Rear Axle		x	
*Total	54	114	
Ventilation Systems	32	21/ 50	
Theory of Refrigeration Cycle		x	
Types of Refrigerants		x	
Components of an Air Conditioning System and Their Function		x	
Principle of Heating System		x	
Major Components of Heating System		x	
Heater	x		
Air Conditioner	x		
*Total	32	71	
Transmission	216	65/345	5/35/10
Conventional (including clutches)	x	x	
Overdrive	x		
Automatic	x	x	
Automatic Transmission Minor Service			x
*Total	216	410	50
Body Services	22		1/ 0/ 28
Door, Hood and Trunk	x		
Window Mechanism	x		
Convertible Tops	x		
Glass and Trim	x		
Automobile Cleaning Service			x
*Total	22		29

TABLE 44. COURSE CONTENT AND HOURS OF INSTRUCTION FOR SUBENTRY LEVEL, ENTRY LEVEL, AND QUALIFIED AUTOMOTIVE MECHANICS (CONTINUED)

Miscellaneous		14/7	24/18/4
Orientation		x	x
Tools and Equipment		x	
Tool Room Procedure		x	
Shop Orientation			x
Parts Manual		x	x
Appearance Housekeeping, and Safety		x	x
Introduction to the Automobile			x
Customer Relations			x
*Total		21	46
Tune-Up		49/170	2/76/105
Fundamentals of the Internal Combustion Engine		X	
Review of Fuel System Principles		X	
Electrical System		X	
Principal Equipment Required for Tune-up		X	
The Testing Procedure			X
Lubrication and Preventive Maintenance Procedure			X
*Total		219	182
Total Course Length	1080	1764	1260

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*Total instruction time in hours including classroom, laboratory, and shops, for respective course unit.

**Numbers represent hours of instruction; if a single number appears, it represents total instruction time (classroom and laboratory and shop), if two numbers appear the first is classroom, the second is laboratory and shop; if three numbers appear they represent hours in classroom, laboratory and shop respectively.

XUnit included in course outline.

schools. It is not intended, or expected, that all schools should hew to the same line; consequently, a range of standards is provided.

5.2.2. POST-SECONDARY VOCATIONAL TRAINING PROGRAMS. Post-secondary school occupational training programs may be directed at any one of three levels of skill training: job entry, occupationally skilled, or semi-professional. The first is relatively short (less than a year), does not require high school graduation, and does not generate credit toward a degree. The second may take one or two years to complete, might require high school graduation, and might generate credit toward a degree. The third generally takes less than three years, usually requires a high school diploma, and usually terminates in an associate degree; those who complete the associate degree frequently continue their education and complete the bachelor's degree.

While the four year colleges may offer training in any of these skill levels, they tend to favor the associate degree programs, which are more compatible with their academic inclinations. The community colleges and junior colleges show their largest enrollment in the occupationally skilled category, but commonly supplement these courses with advanced work leading to an associate degree. None of the post-secondary schools are involved, wholesale, with the entry-level programs at this time. However, since entry-level training seems to be most appropriate to the role of the community college, i.e., to serve that segment of the population that is less academically inclined but no less deserving of the opportunity to learn, it is probably that the future will bring greatly increased activity in this area.

Job Market Orientation. Colleges normally train to a higher level of skill and competency than do high schools, and they frequently reinforce the training with college level academic subject matter, such as English composition, mathematic and social studies. Consequently, the job market toward which the post-secondary schools are oriented begins at the upper edge of operative competency, but is, in effect, aimed at the lower edge of the management function. While the occupationally skilled courses produce knowledgeable and competent automotive mechanics, the consensus of opinion, among employers as well as educators, is that college course graduates seldom practice the mechanic's trade for long; they are, in general, destined to move up quickly.

The post-secondary schools prepare the bulk of their auto mechanic course graduates for either of two basic careers: the certified automotive mechanic and automotive shop management. Thus, the most likely employer of the college trained mechanic is the new car dealership, first, because dealerships have historically paid the best wages and are most likely to make the best offer and second because the organizational structure of the dealership garages, in general, provides the majority of lower level management positions toward which the college automotive student has been directed. Other large scale employers of automotive mechanics, such as truck fleet operators and automotive manufacturers, constitute an important part of the job market for both the occupationally skilled trainee and the semi-professional technician who holds the associate degree.

Labor Force Involved. The student who seeks improved employment opportunity through post-secondary education enters the labor market at a more acceptable age and with generally better training than does the secondary school graduate. Since the student is presumed to have voluntarily invested his own time and money in the advanced occupational training, it is assumed that the motivation is stronger, even though the occupational goals may be no more clearly defined than those of the high school student. Although these young men, by and large, must be classified as inexperienced, employers usually are willing to waive the experience requirement in view of the superior training and increased maturity.

Although these are technically entry-level people, and as such constitute a part of the pre-employment labor force, their training and maturity permit them to compete successfully with the experienced worker who has not enjoyed formal occupational training, or with the high school graduate who has had training, but lacks experience and maturity. Even though these people are a unique group, being qualified but inexperienced, they do not greatly affect the job market, since they are a relatively small labor force. The figures compiled by Duis [71] indicate that while current enrollment is about 17,500 per year, completions stand at slightly over 4000. Consequently, their impact on the job market is minimal.

Sponsorship and Financial Support. The post-secondary schools rely basically on the same sources of support as do the secondary; i.e., local property taxes and appropriations by the state legislatures. Institutions are also eligible for funds under a variety of state and federal acts, and, in addition, colleges are frequently the recipients of donations, bequests, and grants from individuals, businesses, and foundations.

It will be noted from Table 40 that the cost per pupil for college training is almost three times as great (2.9) as the cost per pupil at the secondary level. Since there are slightly over 3.5 times as many high school auto mechanic trainees as there are college level trainees, the cost of the secondary school programs still exceeds the cost of the college programs in terms of tax support. Most colleges, however, whether two year or four year institutions, require payment of tuition, where the high schools, in general, do not. Hence, the total cost of the college level programs quite likely exceeds the total cost of the secondary school programs.

Although no data were gathered on the earnings of the college level auto mechanic students, it is assumed that a substantial proportion of these students are employed during the period of their enrollment. The assumption is confirmed by Mr. Bruce Welch, Director of the Washtenaw Community College Automotive Center, Ann Arbor, Michigan, who indicated in an interview [76] that the majority of the auto mechanic students with whom he was associated worked part time during the semester and full time between sessions. Further, employment was most often as an automobile mechanic or in a related occupation.

Enrollments Completions and Job Placements. The report of the Advisory Council on Vocational Education [27] indicates that there were 14,855 enrollments in post-secondary level automotive mechanic training programs in 1966 (see Table 40). The unpublished work by Duis [7]] showed that in 1968 the total enrollment was 17,490 auto mechanic students in the college programs. In view of the increased commitment to satisfy the job preparatory needs of all youth, including the non-college bound and the socially and economically disadvantaged, it is assumed that enrollments in post-secondary automotive mechanic training programs will continue to increase.

It must be pointed out, however, that colleges, in general, lose a high percentage of their first year students. There is no reason to believe that the same condition will not exist in the area of vocational training. The information compiled by Duis indicates that less than a quarter (23.4%) of the post-secondary school automotive students completed their training in 1968. There is no way to tell from existing data, however, how many of the 17,490 enrollments actually dropped out of the program, and how many were simply moving on to the second year of training. It can be said that, based on Duis's data, it is necessary to put in 17,490 each year to get 4103 out; but that there is no way to tell how many of the 17,490 are new enrollments, and how many are second semester, third semester, etc.

There is also a serious lack of information on job placements for the college trained automotive mechanic. Where comprehensive data on placements are lacking in the area of the secondary schools, it is virtually non-existent at higher levels of education. Statements made by the majority of employers and educators with whom the question was discussed, however, indicate college automotive course graduates are greatly in demand, and these young men seldom find it difficult to secure a mechanic position if they so desire.

Training Courses, Content and Duration. As with the high school programs, the post-secondary automotive mechanic training courses vary considerably in both duration and course content. The differences in course length are not as great as in the high schools, and the differences in course content are more in the area of related courses than in the automotive work.

Seventeen community college course outlines were examined in detail, and it was found that program length in this sample varied from 684 to 2080 hours. Course content depended primarily upon whether it was a semi-professional associate degree program, an occupationally skilled certified mechanic program, or an entry-level automotive service mechanic program. Generally speaking, the associate degree programs include the greatest amount of academic subject matter and the least amount of shop, or laboratory, work. Tables 45, 46, and 47 present brief outlines of the typical college programs.

5.2.3. ADULT EDUCATION TRAINING PROGRAMS. While the adult education appears to be increasingly popular, the bulk of the training today that is directed toward the out-of-school

Table 45. ASSOCIATE DEGREE COURSE IN AUTOMOTIVE TECHNOLOGY (Lecture, Laboratory, and Related Instructions)*

COURSE NAME	Hours per Week		Semester Hours
	Lecture	Laboratory	
First Semester:			
Hand, Machine Tools, Bench Work	0	6	96
Engine Service, I	1	6	112
Power Train	1	4	80
Electrical Systems, I	1	4	80
English (Oral)	3	0	48
Math (Algebra)	4	1	80
	10	21	496
Second Semester:			
Engine Service, II	1	6	112
Power Train	1	6	112
Braking Systems	1	5	96
Electrical Systems	1	3	64
Math (Trigonometry)	4	1	80
Physical Education	0	3	48
	8	24	512
Third Semester:			
Suspension Systems	1	0	16
Body and Chassis	0	6	96
Fuel Systems	1	4	80
Introduction to Acetylene Welding	0	3	48
Introduction to Electric Welding	0	3	48
English (Composition)	3	0	48
Physics (Mechanics)	4	0	64
Drafting (Mechanical)	1	3	64
Physical Education	0	3	48
	10	22	512
Fourth Semester:			
Diagnosis and Tune-up	1	7	128
Trouble Shooting	1	7	128
Electrical Systems, II	2	3	80
Suspension Systems	0	3	48
Social Studies (Economics)	3	0	48
Physics (Electricity and Magnetism)	4	0	64
	11	20	496
Total			2016

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*Source: Automotive Department, The Williamsport Area Community College, Williamsport, Pennsylvania.

Table 46. OCCUPATIONALLY SKILLED COURSE FOR CERTIFIED MECHANIC (Lecture, Laboratory, and Related Instruction)

COURSE NAME	Hours per Week		Semester Hours
	Lecture	Laboratory	
First Semester :			
Hand, Machine Tools, Bench Work	1	5	96
Engine Service	1	16.5	280
Power Train	1	2	48
Electrical Systems, I	1	2	48
Social Studies--Economics	3	0	48
	7	25.5	520
Second Semester:			
Engine Service	1	14	240
Power Train	1	4.5	88
Braking Systems	1	8	144
Electrical Systems, I	1	2	48
	4	28.5	520
Third Semester:			
Electrical Systems, II	1	5	96
Suspension Systems	1	3.5	72
Body and Chassis	1	5	96
Introduction to Acetylene Welding	1	7	128
Introduction to Electric Welding	1	7	128
	5	27.5	520
Fourth Semester:			
Diagnosis and Tune-up	1	7.5	136
Trouble Shooting	1	5	96
Electrical Systems, III	1	5	96
Fuel Systems	1	11	192
	4	28.5	520
TOTAL			2080

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*Source: Automotive Department, The Williamsport Area Community College, Williamsport, Pennslyvania

TABLE 47. ENTRY LEVEL COURSE FOR AUTOMOTIVE SERVICE MECHANIC (Lecture and Laboratory)*

COURSE NAME	Hours per Week Lecture	Hours per Week Lab	Semester Hours
First Semester:			
Service Orientation and Maintenance	6	18	360
Second Semester:			
Electrical and Fuel System Service	6	18	360
Third Semester:			
Suspension and Brake Service	6	18	360
TOTAL			1080

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*Automotive Department, Delta College, University Center, Michigan.

adult population now comes under the auspices of the Manpower Development and Training Act. There are distinctive differences between the two, however. The primary one is that adult education is basically a night school operation intended to permit the employed adult to continue his training or education, while MDTA tends toward the full-time, subsidized enrollment of the unemployed, under-employed, or socially disadvantaged, out-of-school adults.

Job Market Orientation. Most adults enrolled in night school programs receive training appropriate to the occupation in which they are employed, since adult education is basically an upgrading operation. Many adults do exploit the night school training as a means of access to a new occupation, however. Consequently, the job market related to this level of training is difficult to define, since it may simply involve moving up the ladder with the present employer, or it may require moving to a new employer in order to effect a job advancement. Note that the common factor tends to be job advancement, rather than initial employment.

Labor Force Involved. As previously mentioned, this labor force is fundamentally an employed population. Even where the training involves an entirely new skill, the worker tends to have had extensive work experience, though perhaps in a different occupation. Consequently, in moving to a new job, the worker is not viewed as a raw recruit, but as an experienced worker with limited skill in the new occupation. While this condition is not necessarily reassuring to the potential employer, the situation frequently arises in circumstances where the employer feels obliged to employ the trainee. Thus this labor force is characterized as either experienced and seeking to improve employment status through supplemental skill training, or as experienced and seeking to improve employment status through a newly acquired occupational skill.

Sponsorship and Financial Support. The adult education programs, in general, are administered by the board of education as a part of the public school system. Some state and federal funds are available where the training is for credit toward high school graduation or for basic adult education, i.e., reading, spelling, writing, arithmetic, etc. Where the training is for job upgrading or pre-employment, the programs are usually self-supporting through tuition paid by the students. Where support comes from businesses, or other organizations, it is frequently in the form of pre-paid tuition for eligible participants.

Since many of these students are full-time employees, and are frequently supporting a family, the opportunity to participate in an adult education program depends to a great extent upon the determination of the individual to set aside enough of his income to pay for the training. Although in the case of factory closings or relocations the employer sometimes provides financial assistance, it is usually up to the individual to furnish his own support out of his earnings.

Enrollments, Completions and Job Placements. The 1968 report of the Advisory Council on Vocational Education [27] indicates that 63.3 percent (803,901) of the persons enrolled in trade and industrial vocational programs are in adult education (see Table 39). It also shows that 7.7 percent (98,377) of these enrollments are automotive mechanic students. It does not indicate, however, that 63.3 percent of the 98,377 auto mechanics are in adult education. If that assumption is made, then 62,273 students are enrolled in night school auto mechanic courses.

Using the unpublished data from Duis [71], there were 34,464 students enrolled in adult education auto mechanic courses in 1968. Further, 7,803 of these were in pre-employment training, and 26,661 were in supplemental training for upgrading. Since the Duis figures are from a count of reported enrollments, and the Advisory Council figures are computed from a survey of a sample population, the Duis figures appear to be the most reliable.

As previously stated, there are no data indicating the number of adult education completions. Since the majority of adult education enrollees are shown as supplemental, which implies that they are employed, a tally of completions is probably unnecessary; these people are already a part of the employed labor force, and therefore do not contribute to enlarging it.

For the same reason, a tally of the placements for the supplemental trainees is also needless.

While there is a substantial number of adults enrolled in the pre-employment automotive mechanic courses, no data are available that indicate either the completions or placements of this group. These figures would be useful to have, since the outcome of this kind of training could have considerable importance in the future management of the auto mechanic labor force.

Training Courses: Content and Duration. Adult education night school courses tend to be relatively short; classes meet one night a week, as a rule, for a three or four month period. Courses given for high school graduation credit tend to be longer than those given for vocational training.

The Ann Arbor, Michigan school system, for example, requires 45 hours in courses given for credit and 30 hours in occupational training courses: three hours per night, one night per week, for 15 weeks, and three hours per night, one night per week, for 10 weeks. In contrast, most of the adult education provided by the Detroit public school system is administered under the MDT program. Adult education in Detroit is focused primarily on the unemployed and the under-employed, and is conducted as a day school program utilizing block time adjusted to the needs of the individual students. Some traditional adult education courses in automotive mechanics are offered, however, in one or two of the Detroit technical high schools, on a "come as available" basis. These are 51 hour courses, as a rule, in which the student attends three hours a day, one day a week, for seventeen weeks.

Adult education auto mechanic courses do not ordinarily provide for the comprehensive study of the entire vehicle. These courses usually deal with specific components or systems, such as engines, brakes, carburetor, and front-end, or engine tune-up and voltage control. In general, courses are set up on a unit basis, and the content will vary according to the purpose of the particular offering. Courses are offered predominantly for supplemental training, where job upgrading is the objective. Consequently, the training is likely to be directed toward occupational skills where improved competency, i.e., output, is likely to be rewarded by improved job status, i.e., wages.

Another way of explaining the brevity of the auto mechanic training course under adult education is by comparing them with the standard course. Using the Automobile Manufacturers Association standard of 1080 hours, it is seen that at the rate of three hours a week it would take the adult trainee 360 weeks or 6.9 years of continuous attendance to fulfill the minimum recommended by the industry. As a matter of practicality, therefore, adult education vocational programs are designed to supplement the worker's skill rather than to provide him with a new skill and prepare him for job entry. In view of the above, it is concluded that a detailed explanation of course content and duration would serve no useful purpose.

5.2.4. MDTA INSTITUTIONAL TRAINING. No attempt will be made in this study to trace the evolution and development of federally funded training programs and their administration. A comprehensive account of those activities was published by the U.S. Department of Labor [77] and says, in essence, that the Department of Labor and the Department of Health, Education and Welfare share the responsibility for executing the provisions of the Manpower Development and Training Act. The Office of Manpower Administration, under the Department of Labor is charged with the responsibility of identifying occupations in which training should be offered, recruiting the trainees, and helping the trainees to find employment. The Office of Education, under the Department of Health, Education and Welfare, is responsible for the institutional training itself. On-the-job training programs are the responsibility of the Department of Labor and will be discussed in a later section of this report.

The objective of the MDTA, according to Education and Training: Learning for Jobs [37], is "to solve the dual problem of unmet skill requirements and persistent unemployment." Training under this act was aimed originally at those displaced by technological change and relocated industries. In Manpower Research and Training: A Report by the Secretary of Labor [78], it was recognized that basic or remedial education was also vital to the success of the program. Since its inception, MDTA emphasis has shifted toward the disadvantaged and the hard-core unemployed; it was evident that those who were unable to read, write, or do simple arithmetic were unable to assimilate and use the vocational or pre-vocational training.

Job Market Orientation. As indicated above, the original intention of the MDTA was to alleviate the threat posed by the automation of certain kinds of manufacturing and clerical tasks, and to offset the effects of plant relocation on the job market and labor supply. Thus the initial effort was concentrated on personnel who were experienced and usually skilled in at least one occupational area. The job market available to these people consisted of an extensive array of employers who, in general, were readily able to absorb the retrained workers into their organizations.

As attention shifted away from the transitory problems of the displaced worker and began to focus on the needs of the chronically unemployed, the nature of exploitable jobs also changed. Employers who were able to accommodate the skilled or semi-skilled retrained workers, found difficulty in placing the inexperienced, poorly educated, and marginally trained people toward whom the majority of the MDTA was being directed.

In terms of the automotive service and repair industry, the job market for the MDTA trainees tends to be at the lower levels of the employment ladder, although it extends into all segments of the industry. There seem to be somewhat greater opportunities for these people in the dealerships and automobile factories, where political pressure and public opinion are important motivators, and in government service, where moral obligation operates more effectively. A fourth important job market, particularly in socially disadvantaged areas, is subsidized entrepreneurship in the trade or in a related occupation.

Labor Force Involved. The emphasis in current MDTA programs is primarily on the chronically unemployed and on other populations that exhibit high levels of unemployment, such as out-of-school youths (drop-outs or otherwise), Negroes, and Mexican-Americans. Consequently, it is not a single labor force involved, but several. While they share the common characteristics of inexperience, inadequate education and training, and social and economic disadvantage, each has specific handicaps in competing in the job market. The chronically unemployed frequently do not know how to obtain a job or how to hold it. Out-of-school youths, particularly the drop-outs, suffer from immaturity, and minority groups, particularly Negroes, suffer racial prejudice.

Statistics on Manpower, A Supplement to the Manpower Report of the President [79] contains extensive statistical data on the characteristics of trainees enrolled in the institutional MDTA programs from fiscal year 1963 through 1968. These statistics, however, do not break the data down into the various occupational categories, but they show how the characteristics of the total population have changed from 1963 to 1968. In 1968, for example, 38.3 percent of this population (including females) was

21 years or younger; it was 51 percent white, and 45 percent Negro; 59.7 percent had 11 years of education or less; 45 percent had less than three years of work experience; 79.8 percent were unemployed; and 82 percent had 52 weeks or less of work experience.

This population is not only limited in its access to jobs because of inadequate education and training, it is also limited in its access to training, whether formal or informal, by the lack of education. Thus, a predominant characteristic of this labor force, in its untrained state, is its general inability to qualify for any but the least rewarding and least permanent positions. Consequently, this population experiences great difficulty in acquiring the degree of job security needed to permit the non-system development of a salable skill.

Where adequate training is provided, however, the situation is different. The MDTA experience shows that those who satisfactorily complete appropriate occupational training courses are able to obtain stable and satisfying employment, and the problem is not a matter of placement but a matter of keeping the trainee in the program long enough to complete the course.

Sponsorship and Financial Support. The Manpower Development and Training Act supports other federal acts including the Area Redevelopment Act, the Manpower Development and Training Act, the Vocational Education Act of 1963, the Economic Opportunities Act, and others. These funds are administered by MDTA under a number of different training programs including MDTA Institutional Training, MDTA On-The-Job Training, MDTA Part-Time and Other Training, Neighborhood Youth Corps, Concentrated Employment Program, Operation Mainstream, New Careers, Special Impact, and the JOBS program.

The Department of Labor reports [79] that the federal obligation for training under the MDTA institutional program was $216,586,000 for fiscal 1968, while the total for all programs was $2,823,019,000. The total MDTA institutional enrollment opportunities are shown as 114,000 and actual enrollments as 140,000. Note that enrollment opportunities are simply training stations, and, since many courses are completed in less than one year, some training stations will accommodate more than one enrollment per year. Consequently, 114,000 enrollment opportunities provided training for 140,000 enrollees in FY 1968.

Using actual enrollments, the cost per trainee for MDTA institutional programs is $1,547.04. Note that this figure may be misleading, since it includes trainees carried over from FY 1967, and many who will not have completed until FY 1969. Similar figures may also be found in the 1969 report of the Secretary of Health, Education and Welfare [80]. All of the MDTA auto mechanic training cost data that appear in the annual reports of the secretary of Health, Education and Welfare from 1963 to 1969 are included in Appendix B.

Note that the above figures do not represent total cost. Most of the early MDTA programs were carried out in the public high school, and, consequently, a substantial portion of the cost was borne by the community. With the shift of training emphasis to the MDTA Skill Centers, which have been established in 70 metropolitan areas throughout the country, the states are now required to provide 10 percent of the funds on a cost-sharing basis. Table 48 is based on information obtained from the Division of Manpower Development and Training, Department of Health, Education and Welfare [81] and shows the cost of training one automobile mechanic in an MDTA institutional program in Grand Rapids, Michigan. While these data are not current and, indeed, may not be representative of a typical auto mechanic training program, they are included in order to provide a gross measurement of the cost of training. No attempt is made to compare this specific program with other skill training or other auto mechanic programs.

TABLE 48. PER PUPIL COST, MDTA INSTITUTIONAL AUTO MECHANIC PROGRAM, GRAND RAPIDS, MICHIGAN (20 PUPILS, 40 HOURS PER WEEK, 26 WEEKS [81]

Cost of Training	$22,124
Cost of Subsistence	40,744
Total Cost	$62,868
Number of Trainees	20
Cost of Training/Trainee	$ 1,106
Cost of Subsistence/Trainee	2,037
Total Cost/Trainee	$ 3,143

The data from *Statistics on Manpower* [79] indicate that approximately 80 percent of the MDTA institutional trainees are unemployed. Thus, it can be assumed that the major source of income for the majority of the MDTA enrollees is the subsistence payments provided under the training program. Since most of the programs are set up on a full day basis, five days a week, it is expected that the opportunity for these students to earn other money is limited.

Enrollments, Completions and Job Placements. According to the Department of Labor [80], a total of 140,000 trainees were enrolled in MDTA institutional programs in fiscal 1968. Of this number, 85,000 completed the training, and 75 percent of those (63,750) were employed at the time of the last contact. The report shows that 7.1 percent (9,940) of the institutional enrollments were in auto mechanic training programs, but completion and placement data are not given for specific occupations. Using the 7.1 percent figure for enrollments, however, approximately 6,035 of these were employed.

Since the figures above are derived from a population previously shown to be distinctly different from the population of automotive mechanics, it should not be assumed that the same completion rate applies equally to both. It is also noted that the report [80] does not indicate whether the employment is in the trade for which the training was given, in a related trade, or in an unrelated trade. Consequently, these data are accepted with some reservations.

The report [80] also indicates that many of the enrollees accept employment before the training is completed. Although these individuals do not complete the program, they cannot, in all fairness, be classed as drop-outs or failures. It is found, in most cases, that the training has been critical to obtaining the employment. These individuals are now reported, therefore, as 'early completers', and will be shown as such in future statistical summaries.

Training Courses: Content and Duration. As previously mentioned, the most distinctive characteristic of the MDTA automotive mechanic training courses is the block time feature. Since these courses are basically intended for out-of-school people who are unemployed and whose primary need is to develop a salable skill, it is important to compress the training as much as is practical and to provide as much skill practicing time as is possible. Consequently, the programs usually require full-time attendance, i.e., seven or eight hours a day, five days a week. While adjustments are made in order to accommodate the needs of the individual student, the courses generally are planned around full-time attendance.

Like other automotive mechanic courses reviewed, the MDTA courses are prepared according to the needs of a particular locality. Thus, there is considerable variation allowed within the general outlines of approved course content and duration. Table 49 shows the distribution of subject matter and hours of

TABLE 49. DISTRIBUTION OF SUBJECT MATTER AND CLASSROOM HOURS IN MDTA INSTITUTIONAL TRAINING COURSES ENTITLED: "AUTO MECHANIC (ENTRY)"

	Engines	Fuel System	Electrical System	Suspension System	Braking System	Drive Line	Trans-mission	Differential and Rear Axles	Ventilation System	Body Services	Tools and Welding	Miscel-laneous	Service	Total Hours
1	250	60	150	100		180					20	12	220	1000
2	380	90	280	20	80	20					50	2	98	1020
3	240	54	75	108	54	72						554	851	2008
4	544	132	212	132	112	292						16		1440
5	153	112	207	256		122					16	12	590	1468*
6	500	220		200										1160*
						240								
7	450	250	300	150	100	200					12	8	30	1500
8	650	300		300									450	2000
						300								
9	100	70	100	50								50	470	840
10	710	230	200	160		200						75		1575
11	580	340		220		370								2000
							310		180					
12	1000	30	120	165	100	40	200	80			40	95		1950*
									80					
13	280	40	144	104	80	16	184	96			72	8		1040
									16					
14	180	50	50	220	40	50	170	50	40				350	1200
15	260	100	420	300								100	240	1420
16	650		450	550								190		1840
17	510	150	180	260	90	360								1550
18	360	190	320	300								100	260	1530
19	370	105	390	420								80	210	1575
20	460	150	200	260	100	30	170	75		5	30	90	15	1585*

Note:Courses 1 through 7 are also identified by DOT code 5-81.010

* Detail course hours do not total reported total hours.

twenty representative MDTA course outlines obtained from the Division of Manpower Development and Training. While these couse outlines are all identified by the occupational title "Automobile Mechanic", or "Automobile Mechanic - Entry", many of them are also identified by the formerly used DOT Code for Automobile Mechanics, i.e., 5-81.010. The entries on the table are identified accordingly.

The individual subject matter areas are, for all practical purposes, the same as those shown for the secondary school courses. There are two notable differences: the driveline components (propeller shaft and universals) are not shown as a separate category of subject matter, and in a number of cases laboratory or shop work appears under the heading of service.

The standard courses for the MDTA automotive programs are those shown as Course B and Course C in Table 44. The B course [74] was developed by Maurice W. Roney, Professor of Industrial Education, Oklahoma State University, and is intended to train the student beyond the entry level. This course will qualify the trainee to accept a position as an entry level automotive mechanic, and will prepare him to advance beyond that point. The C course [75], developed by Arthur J. Oettmeier while he was the Head of the Automotive Department, Ferris State College, Big Rapids, Michigan, was designed to assist persons of limited experience and ability in becoming self-sufficient gasoline service station attendants who are capable and qualified to perform minor repairs and adjustments on motor vehicles.

The U.S. Office of Education published Automotive Engine Specialist: A suggested Guide for a Training Course [82]. This course was also developed by Oettmeier and is intended, as the title suggests, to train engine overhaul mechanics in MDTA skill centers. Table 50 presents a brief outline of the engine overhaul course.

TABLE 50. CRITERION COURSE FOR MDTA AUTOMOTIVE ENGINE OVERHAUL MECHANIC [82]

	Number of Hours		
Engine Orientation and Maintenance	Classroom	Laboratory	Shop
Job Orientation	2	0	0
Shop Orientation	3	2	4
Shop Safety Procedures	3	2	0
Engine Classification	7	0	0
Engine Types	2	1	0
Automotive Mathematics	40	0	0
Engine Components and Related Accessories	4	8	0
Specialized Tools and Instruments	28	21	0
Interpreting Terminology and Specifications	18	25	0
Recommended Maintenance Procedures	4	0	0
TOTAL	111	59	4
Engine Damage Diagnosis and Repair			
Cost Estimate			
Customer Relations	2	0	0
Engine Diagnosis External	6	16	0
Engine Diagnosis Internal	8	16	0
Estimating Repair Costs	8	16	0
TOTAL	24	54	0
Engine Disassembly Process			
Cleaning and Checking Components	12	40	0
Machining Components	60	72	288
Preparing the Part Order	8	16	0
Engine Disassembly	2	8	0
TOTAL	82	136	368
Engine Reassembly Process			
Engine Assembly	12	16	25
Engine Installation	2	8	0
Final Engine Testing	2	7	0
TOTAL	16	31	25
GRAND TOTALS	233	280	397
TOTAL COURSE HOURS		910	

5.2.5. COMMERCIAL TRADE SCHOOL TRAINING PROGRAMS. Since many of the vocational schools in the public high school system incorporate the phrase 'trade school' in their names, it is noted that the term 'commercial trade school' is used in this study to denote a school that is operated, usually for profit, by an institition other than the public school system. While many of the commercial trade schools are indeed run by small, autonomous private groups, there are also organizations that operate on a national scale. The Lincoln Technical Institute, located in Newark, New Jersey, operates branch schools in Washington, Philadelphia, Baltimore and Indianapolis, and franchises the operation of trade schools in Des Moine, Denver, Dalas, and Phoenix.

Commercial trade schools offer two kinds of automotive training courses: those that entail the comprehensive study of the entire automobile (or truck), and those that are addressed to one system or component of the automobile, such as gasoline engine or diesel engine, front-end alignment, collision repair, automotive electric, welding, painting, etc. The majority of the trade school courses appear to be directed toward the specialties, although the comprehensive programs are readily available.

Job Market Orientation. These schools are oriented toward all of the places in which the full range of automotive maintenance and repair work is done, and, in addition, toward all of the specialty shops that cater to specific kinds of maintenance and repair. The commercial trade schools enjoy a unique position in the market, since their graduates are generally well-trained young men who are highly motivated to succeed in a preferred occupation. Consequently, establishments of all kinds that employ automotive maintenance and repair personnel frequently seek out the commercial trade schools when there are mechanic openings to be filled.

Labor Force Involved. The labor force generated by the commercial trade schools is composed largely of young men recently graduated from high school. While high school graduation is not necessarily a prerequisite for enrollment in a commercial trade school, the majority of enrollees are at least in that age bracket. Since these trainees are people who, in general, have elected to become auto mechanics, they are inclined to be intensely interested in the subject matter and in mastering the attendant skills. Consequently, they are inclined to be dedicated to the occupation and, under good management, usually become highly competent mechanics in a relatively short time.

Sponsorship and Financial Support. The commercial trade schools, as the name implies, are commercial operations in the business of, in this case, training automotive mechanics. As such, the student is required to pay tuition, and the tuition is the primary source of operating funds and profits. They depend greatly upon a good reputation in the industry for their continued existence, since it is primarily through a good reputation that they are able to attract new students.

Other sources of income for the schools include the sale of books, tools and school supplies. An additional, very important source derives from the repair and maintenance of "live" motor vehicles; in other words, the schools are, in a limited way, in the garage business.

Following World War II, many commercial trade schools were approved by the Veterans Administration to give occupational training under the provisions of the "GI Bill." Subsequently, veterans of World War II and the Korean conflict accounted for a significant proportion of the commercial trade school enrollments, thus the federal government became a primary source of funding for these schools. Since federally supported training programs are still available to returning servicemen, the government continues to be an important source of revenue for the commercial trade schools.

The commercial trade schools are also eligible for MDTA funds, when they are able to provide services or equipment not available in the public institutions, or when they can render special assistance to the MDTA objectives. In 1968, 30,000 institutional trainees were enrolled in private schools [80]. Note that this includes trainees in all occupations; what proportion of these might be automotive mechanics, if any, is not explained.

Although many of the students attending the commercial trade schools do work on a part-time basis and in some cases are paid a stipend by the school for work on "live" vehicles, they ordinarily attend on a full-time, forty hour a week basis. Consequently, both the opportunity and the desire to seek extra curricular employment are reduced.

Enrollments, Completions and Job Placements. The review of the literature and search of the published statistical data reveals almost nothing about enrollments and completions in commercial trade schools. While about twenty of the fifty states require some form of licensing of commercial trade schools, none of them apparently keep records on enrollments or completions. Michigan, for example, licenses trade schools, and keeps a record of the training courses offered by each, but it does not require the reporting of enrollments in specific occupational course.

The National Association of Trade and Technical Schools, which might be expected to compile such data, is primarily an accrediting organization and does not gather information of that kind. The Veterans Administration, which financed a great many trade and technical students under the GI bill following World

War II and Korea, has extensive information relating to these programs, but apparently did not include such information in its computerized record keeping system.

Bedell indicates [26] that 16 percent of the auto mechanics received training in special schools and 4.4 percent received training in technical institutes. But since neither of these terms are defined, it cannot be assumed that either or both of them are synonymous with the term trade school. It is probable, however, that at least a portion of those enrollments are accounted for by trade schools, although it is impossible to say how many. Bedell's report shows that 9.8 percent of the craftsmen, formen, operatives and kindred workers received training in trade or business school. This occupational group includes auto mechanics, but, again, the statement is very general and is not readily applicable to the automotive mechanic.

The Snow study [10] indicated that a very high percent (33%) of the mechanics had received commercial trade school training. However, Snow himself concludes that the survey upon which he based the figures was subject to bias and misinterpretation by the respondents; thus, it appears that the information is not reliable.

Training Courses: Content and Duration. Since trade schools are basically profit-making institutions, the courses they generated aim at maximum development of competency in minimum time. Classroom work is therefore minimized, and maximum attention is devoted to practical training in the shop. As previously noted, much of the work is performed on "live" vehicles. Consequently, there is a great deal of supervision and generally a low pupil to instructor ratio.

Trade school programs can be characterized as intensified, short-term courses emphasizing the practical, "hands-on" training that leads to rapid development of manipulative skill. Many of the courses, such as front-end alignment, may be compressed into two weeks, where previous experience, or familiarity with the subject matter, is a prerequisite. Courses intended to train fully qualified automobile mechanics may take from six months to one year.

Because courses vary widely both in content and duration, no attempt is made to present specific course outlines. As previously mentioned, the courses devote the least possible attention to the classroom work and bear down hard on the laboratory or shop work.

5.3. THE WORK-ORIENTED SYSTEM

The work-oriented system is the aggregate of training efforts under the direction and supervision of an employer. Eligibility is controlled by the employer, and an employed status is usually a prerequisite to participation. The basic purpose of the work-oriented system is to assure the economic health of the organization through the upgrading of employee competence. While a modest amount of entry-level training is accomplished, the main thrust of this training is to improve the performance of the established employee. This system includes apprenticeship, MDTA on-the-job training, manufacturers' training and Armed Forces training.

5.3.1. THE APPRENTICESHIP TRAINING PROGRAM. Traditionally, a formal, four-year apprenticeship program is recommended for entry into a skilled trade. Lesh indicates that [4] apprenticeship is the most frequently suggested "best" way to become an automobile mechanic. At the same time, however, he points out that there are valid criticisms of the method; the most obvious is the difficulty of recruiting young people into the program. Although the ultimate rewards are high, the starting wage is very low, and youth is reluctant to spend so much time doing it the hard way, when other avenues to rich rewards are close at hand.

Job Market Orientation. The job market toward which apprenticeship training is ultimately directed consists of journeyman positions with all employers of highly skilled auto mechanics. The employment of apprentices, however, is limited to those employers who are operating approved apprenticeship training programs. Thus, the apprentice himself faces an extremely limited job market. Yet, once he is indentured to an employer, the apprentice enjoys what is essentially a captive market, since there must be an assurance of work on the part of the employer, just as there is an assurance of performance on the part of the apprentice.

Although apprenticeship programs are found in all segments of the industry where the full range of automotive maintenance and repair work is carried out, they occur most frequently in the larger dealerships and independent repair shops. Apprenticeship programs require the approval of the Bureau of Apprenticeship Training, in the Department of Labor, as well as approval by the controlling state authority. Consequently, apprenticeship programs are found predominantly in businesses that are well established and economically healthy.

Labor Force Involved. Since the apprenticeship training program implies a long-term commitment to the apprentice, (on the part of the employer) the employer is inclined to be highly selective in choosing an apprentice. The result, by and large, is that those who are industrious, reliable and motivated are selected for the program, and those who are lacking in the desirable characteristics are not selected. In addition, since high school graduation is a common requirement, the apprentice is likely to be better equipped, educationally, than many with whom he competes for jobs and advancement (see Table 32). A large share of this labor force, like that trained in the post-secondary schools, becomes highly skilled career mechanics and management level people in the industry.

By definition, an apprentice is one who is learning by experience under skilled workers. Consequently, this is a population of learners, and it is characterized by a condition of forced upgrading, since failure to progress is grounds for dismissal from the program. In other words, this labor force includes everything from raw recruits, at the entry level, to journeymen mechanics, at the completion level. Thus the work that apprentices are qualified to do includes the complete range from practically nothing to practically anything, and they are classified, skill-wise, according to the number of years of training completed.

Sponsorship and Financial Support. The automotive mechanic apprenticeship programs are sponsored by two types of organizations, both of which work in close cooperation with the Bureau of Apprenticeship and Training, under the Department of Labor. One type consists of industry associations, such as the Independent Garage Owners of America (IGOA), the National Automobile Dealers Association (NADA), and the Automotive Trade Association Managers (ATAM). The other type consists of labor unions, such as the International Association of Machinists (IAM), the American Federation of Labor (AFL), and the Congress of Industrial Organization (CIO).

The initial function of the sponsoring organization is to determine what body of knowledge and what array of skills are required by the journeymen in their occupation. Having established what these needs are (for the applicable trades), a program of training must then be devised to assure that no critical area of skill or knowledge is overlooked. Then, having developed the policies and methodology to properly guide the program, the sponsor must obtain the approval of the Bureau of Apprenticeship and Training before actual apprenticeship training can commence.

The subsequent functions of the sponsor are to assist and advise its members in setting up training programs and to review and up-date the training programs so that they continuously reflect the current needs of the industry and the community.

The Bureau of Apprenticeship and Training, however, is chiefly responsible for operation of the apprenticeship system in the United States. Consequently, all apprenticeship programs, in practice, are developed in close cooperation with the Bureau. The U.S. Department of Labor provides basic guides for apprenticeship training [83, 84] which spell out the legal requirements that must be met by any organization that wishes to participate in a registered apprenticeship training program.

The financial support of apprenticeship training is borne primarily by the employer. While the sponsoring organization incurs a considerable amount of expense in setting up and administering an apprenticeship training program, the funds come from membership fees and assessments levied against the members of the association. The members, in this case, are either employers or union members; both contribute, one way or another, to the funding of the program.

The apprentice, himself, is paid by the employer under the terms of a written contract which both must sign. The wage for a beginning apprentice is usually about half the union scale, or the going wage, of the journeyman mechanic. While the pay scale of the apprentice is set by the official apprenticeship standards of the specific organization, the employer may exceed the scale if, in his opinion, higher pay is warranted. Table 51 is a recap of the 1966 IGOA apprenticeship pay scale.

Enrollments, Completions and Job Placements. Bedell shows [26] that as of April 1963 1,785,000 auto mechanic training programs had been taken. Of this number, 6.3 percent, or 112,455 were apprenticeships. That study, however, does not indicate

TABLE 51. APPRENTICE EARNINGS [86]

Apprentice Wage Schedule (1,000 hours)	Percentage of Journeyman Scale
First 6 months	55
Second 6 months	60
Third 6 months	65
Fourth 6 months	70
Fifth 6 months	75
Sixth 6 months	80
Seventh 6 months	85
Eighth 6 months	90
Average percentage	73.1

how many of those 112,455 were employed as mechanics at that time.

The 1963 Manpower Report of the President [85] prepared by the U.S. Department of Labor, records that there were 3,723 registered auto mechanic apprentices in 1950 and 1,771 in 1960, a drop of 52.4 percent. This report also shows that the population of automotive mechanics increased from 654,350 to 682,103, up 4.2 percent, at the same time.

The 1965 Manpower Report of the President [87], which also contains the Secretary of Labor's report, is based on 1963 data, and shows that there were 3,455 active registered automotive mechanic apprentices at the end of 1963. Figures based on as yet unpublished 1968 data were obtained from Paul H. Vandiver [88]. These data show that there were 7,611 active auto mechanic apprentices at the end of 1968. Table 52 is included to show the growth of the apprenticeship form of occupational training.

TABLE 52. GROWTH OF REGISTERED APPRENTICESHIP TRAINING*

Occupation	Year	Active: Start of Year	New Starts	Completed	Cancelled	Active: End of Year
All Trades	1963	158,887	57,204	26,029	26,744	163,318
All Trades	1967	207,511	97,896	37,299	47,957	220,151
Metal Work	1963	23,538	9,019	3,799	3,927	24,831
Metal Work	1967	44,757	30,669	8,470	12,357	54,599
Automotive	1963	3,366	1,380	443	848	3,455
Automotive	1968	5,463	4,547	705	1,694	7,611

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*Sources: 1963 data from reference 87
1967 data from reference 77
1968 data from reference 88

It can be inferred from Table 52 that, although there is a continuous increase in apprenticeship training, the system does not contribute significantly to the growth of the total mechanic population. Many of those who enter the program are already a part of this population, and many of those who fail to complete training remain in the trade. Thus, while completion may be a problem, placement is not, since the apprentice is already employed in the industry.

Training Courses: Content and Duration. The apprenticeship training courses, as previously indicated, are generated by the sponsoring organization with the approval of the Bureau of Apprenticeship and Training. Since these organizations represent a variety of businesses, each of which requires a unique combination of automotive maintenance and repair activities, each develops a unique training program. Consequently, each program utilizes a distinctive body of knowledge and array of manipulative skills; engine rebuilders and body rebuilders work on the same automobile, but they speak a different language. This explains why there is not a single automotive apprenticeship program approved by the Bureau of Apprenticeship and Training, but many.

Four different apprenticeship standards are presented in this study, providing a representative sample of dealership and independent shops as well as of management and union viewpoints.

The Independent Garage Owners of America, in conjunction with the Bureau of Apprenticeship and Training, published a standard entitled Apprenticeship and Training Standards for Automobile Mechanic, Body Repairman and Painter [86]. The 1966 edition contains the standards for three categories of apprentices: (1) automotive mechanic (automotive repair shop); (2) body and fender mechanic; and (3) automotive painter. The pamphlet explains in detail the requirements and responsibilities of all parties, and provides an outline of the recommended work experience schedules, pay schedules, ratio of apprentice to journeyman mechanic, related instruction, hours of employment, etc. The content and duration of the automotive mechanic work experience schedules are shown in Table 53 in brief outline form.

The standards published by the National Automobile Dealers Association and the Automotive Trade Association Managers [89] contain basic information and give the specific content and furation of apprenticeship courses in (1) auto mechanic (passenger); (2) heavy-duty truck mechanic (truck repair over 10,000 lbs., G.V.W.); (3) body repair mechanic; and (4) body painter mechanic. The content and duration for the automotive mechanic experience requirements listed in this standard are also given in Table 53.

Similar information from the International Association of Machinists [90] is included in Table 53. This standard, while it lists pertinent course content and hours information, is aimed primarily at clarifying the contractual status of the apprentice-

TABLE 53. CONTENT AND DURATION OF APPRENTICE AUTO MECHANIC WORK EXPERIENCE SCHEDULES

	1 [86]	2 [89]	3 [90]	4 [91]
Introduction and Orientation	500		500	
Lubrication				
New Car Preparation	x	x*	x	
Shop Routine	x		x	
Brakes	500	x	500	600
Adjust	x		x	
Reline	x	x	x	
Hydraulic System	x	x	x	
Power Brakes	x	x	x	
Air and Vacuum Brakes	x		x	
Disc		x		
Cooling		x		
Turning Brake Drum		x		
Chassis	750		750	1,800
Frames	x	x*	x	x
Steering Units	x		x	x
Front Systems	x	x	x	x
Shock Absorbers	x	x	x	
Springs	x	x	x	x
Shackles	x	x	x	
Wheel Alignment		x		
"A" Frames		x		
Clutch and Transmission	1,250		1,250	1,000
Clutches	x	x*	x	
Transmissions:				
Standard	x	x*	x	
Automatic	x	x*	x	
Overdrives	x	x*	x	
Shift Controls	x		x	
Power Takeoff	x		x	
Rear Axle	750		750	1,000
Differential	x	x*	x	
Universal Joints	x	x*	x	
Drive Lines	x	x*	x	
Rear Axle	x	x*	x	
Engines	1,500	x	1,500	2,000
Valves	x	x	x	
Timing Gear and Chains	x	x	x	
Pistons and Rings	x	x	x	
Crankshaft and Bearings	x	x	x	
Cylinder Reconditioning	x	x	x	
Cooling System	x	x	x	x*
Connecting Rods		x		
Camshafts		x		

TABLE 53. CONTENT AND DURATION OF APPRENTICE AUTO MECHANIC WORK EXPERIENCE SCHEDULES (CONTINUED)

	1 [86]	2 [89]	3 [90]	4 [91]
Electric System	1,000		1,000	x*
Wire System	x		x	
Light System	x	x*	x	
Generator	x		x	
Regulator	x		x	
Motors:	x	x*	x	
Starting	x	x*	x	
Windshield Wiper	x	x*	x	
Instruments and Gauges	x	x*	x	
Ignition	x		x	x*
Battery	x		x	
Transmission Controls	x		x	
Radio		x*		
Fuses		x*		
Solenoids		x*		
Alternators			x	
Motor Analyzing	1,250		1,250	1,600
Carburetors	x	x*	x	x
Fuel Systems	x	x*	x	x
Distributors	x		x	
Trouble Shooting	x		x	
Fuel Injectors	x	x*	x	
Tune-up	x		x	x
Spark Plugs		x*		
Miscellaneous	500		500	<125
Exhaust System	x	x*	x	
Welding	x		x	
Auxiliary Devices	x		x	
Shop Operations	x		x	
Service Selling	x		x	
Supervision	x		x	
Review	x		x	x
Air Conditioning		x		x*
Light Truck Repair		x		
Body Adjustments		x		
Body Maintenance	x*	x	x*	
Total Hours	8,000	6,000	8,000	8,000 to 8,125

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*Covered in different unit or unit with different name.

ship program (in terms of labor contract). It includes: (1) machinist; (2) tool and die maker; (3) machinist (railroad diesel power); (4) automotive mechanic (general shop repair); (5) automotive mechanic (machine shop); (6) automotive mechanic (body and fender); (7) air transport mechanic; and (8) electronic technicians. Only the experience content and hours for the automotive mechanic (general repair shop) are included in Table 53.

The fourth standard, published by the Greater St. Louis Automotive Associations, Inc. [91] includes: (1) automobile mechanics; (2) body repair mechanics; and (3) automotive painters. As with the others, only the experience schedule of the automobile mechanic is shown in Table 53.

A minimum amount of related instruction, usually 144 hours, is also required each year during the term of the apprenticeship. Related instruction is usually defined as classroom instruction, and/or the study of books, manuals, or other prepared instructional materials. Although it may be self-taught, either on or off the employer's premises, it is frequently provided for by special arrangement with the local public schools. The subject matter may include mathematics, blueprint reading, safety or any theory related to the trade. The classroom instruction may also include topics such as foremanship, customer relations and workshop management. Courses conducted by product schools, such as manufacturers' training classes, are, in some cases, credited against the 144 hour requirement.

5.3.2. MDTA ON-THE-JOB TRAINING PROGRAMS. In addition to formal occupational training in the schools, the MDTA authorizes the shared-cost training of individuals who would not otherwise be qualified for employment. In this arrangement, the MDTA compensates the employer for hiring and training the inexperienced or unqualified. The system is relatively simple; the employer provides a job, appropriate and systematic instruction and a portion of the trainee's pay. The MDTA selects those who are to be trained, approves and monitors the specific programs and reimburses the employer for costs in excess of normal training activities and the balance of the trainee's pay.

Job Market Orientation. While companies of any size are eligible to contract with the government to participate in an on-the-job (OJT) program, experience indicates that OJT is most frequently sought by the larger employers and unions. Consequently, the job market toward which OJT is directed consists mainly of entry-level positions with large firms located in the metropolitan areas.

In terms of the automotive service and repair industry, the controlling factor is the relative success and stability of the employing firm, rather than the kinds of specific occupational skills involved. The participating employer may be a dealership garage, an independent garage, a parts supplier, engine rebuilder, or any of a dozen specialized businesses. The common denominator, occupationally, is that the jobs are at the lower end of the spectrum from the standpoint of skill, pay, and prestige.

Labor Force Involved. At the beginning of the MDTA, emphasis was placed on retraining workers displaced by automation and plant relocation. In 1966, however, the program was formally redirected to accommodate more adequately the disadvantaged and the hard-core unemployed. It was decided than that 65 percent of the total MDTA effort would be directed to training the disadvantaged and that 35 percent would be devoted to meeting the need for trained personnel in occupations with skill shortages. A disadvantaged person was defined, for manpower program purposes, as one having two or more of the following characteristics: non-white, with less than 12 grades of education, unemployed at least 15 weeks, under 22 years of age, 45 years of age and over, handicapped, or a public assistance recipient.

Two things result from this change in policy. First, a higher proportion of those selected for training are poorly equipped, socially and academically, to assimilate the training or to perform satisfactorily in a job once it is secured. Second, the jobs in which these people are able to function effectively are those that, by nature, require relatively low levels of skill and ability. The characteristics of this labor force imply relatively long training times, low ceilings on achievement, and limited advancement, i.e., pay.

Statistics on Manpower [79] shows that 35.1 percent of the OJT population is 21 years old or younger, and 40.0 percent are 22 to 34. It also shows that 64.4 percent of the trainees are white and 32.9 percent are Negro; 39.9 percent completed 11 years of school or less, and 43.7 completed 12 years. According to these data, the OJT population is slightly older, less poorly educated, more predominantly white, and has had considerably more work experience than the MDTA institutional trainee. OJT people were 66.5 percent unemployed, compared to 79.8 percent unemployed for MDTA institutional trainees. Thus, while the OJT trainee is indeed handicapped in the job market, he seems to be somewhat better off than the MDTA institutional trainee.

Sponsorship and Financial Support. The 1969 Manpower Report of the President [77] indicates that an important development in the OJT program is the negotiation of training contracts designed to operate over a large geographic area, such as several states. These contracts may be with a large company, a trade or professional association, or a union whose scope of operation is nationwide. Sponsorship on this scale simplifies the recruiting of participating companies, expedites the training for shortage occupations and provides access to employment for the disadvantaged and chronically unemployed. By working through big organizations, the need to develop individual contracts with a multitude of small business places is eliminated, which reduces the cost and increases the efficiency of the MDTA OJT training program.

The improvement in efficiency is most readily seen in the per pupil training cost. The 1969 Manpower Report of the President [77] reports that the average cost to the government of MDTA OJT is approximately $650 per trainee; this is more than $900 below the average for the institutional program. Although there was a moderate drop in funds obligated for all MDTA training projects, institutional and OJT (from $347 million in 1967 to $332 million in 1968), it was possible to maintain the number of enrollments because of the greater emphasis on the lower cost OJT programs.

Although cost figures for the specific occupations are not reported, Education and Training: A Chance to Advance [80] indicates that $89,837,000 in federal funds was obligated for OJT in 1968. Since the report also indicates that three percent of the enrollments were motor vehicle mechanics and repairmen, the cost to the federal government for OJT auto mechanic training can be estimated at three percent of $89,837,000 or about $2,695,000. This produces a per trainee cost of about $718 for auto mechanics, which should not be taken as an accurate estimate, since it is based on information of a very general nature.

Since the OJT trainees are employees of the contractor conducting the training, the income of the trainee is determined by the local wage scale. And since the training opportunities are generally in the entry-level category, the wages paid to OJT trainees are likely to be near the bottom of the wage scale. Although no specific information is given in either the Department of Labor report for 1969 [77] or the Department of Health, Education and Welfare report for 1969 [80] on the wages of persons in training, it is assumed that the hourly pay rate would fall between $1.25 and $3.00 per hour, which are the extremes of the post-training wages reported in Education and Training [80].

Enrollments, Completions and Job Placements. The data on enrollments, reported in *Education and Training* [80] show that three percent of the OJT enrollments were motor vehicle mechanics and repairmen. Since total OJT enrollments for fiscal 1968 were 125,000, enrollments in automotive mechanic training programs are computed at 3,750. This source also indicates that there were 60,000 OJT completions in fiscal 1968. If the proportion of auto mechanics is the same for this population as for the enrollment population, then 1800 auto mechanics completed their training in fiscal 1968. Further, the report shows that 85 percent, or 51,000 of the completers had been employed at some time during the first year after training. On this basis, 85 percent or 1530 of the 1800 auto mechanic completers found employment following the training experience.

The 1969 *Manpower Report of the President* [77] shows that 90 percent (49,050) of the OJT trainees who completed in 1967 were employed at time of last contact. A further analysis shows that 85.5 percent were in training related jobs, 5.3 percent were in other jobs and 9.2 percent were not employed. Since insufficient time had elapsed (at the time of the 1969 report, a similar analysis had not been done on the 1968 data. The 1968 data shows that 51,000 OJT trainees had completed training, however; if the 1967 percentages are applied to that number, then 43,605 are in training related jobs, 2703 are in other jobs and 4692 are unemployed. If the three percent automotive mechanic enrollment figure is applied to these numbers, then 1308 trainees are in auto mechanic related jobs, 82 are in other jobs, and 141 are not employed.

The 1969 report of the Secretary of Health, Education and Welfare [80] cites several studies that substantiate the value of the MDTA program. Main, however, concludes, on the basis of a national probability sample, that MDTA training has very little effect on wage rates but has a favorable influence on employment rates [38].

Training Courses: Content and Duration. On-the-job training, as the name implies, corresponds more nearly to the experience related training of the apprenticeship than to the kind of training found in the institutionalized system. In many cases, OJT training is coupled to classroom work where remedial reading, arithmetic and other basic education subjects are required. In 1968, 219,000 training opportunities were authorized, 114,000 in institutional training and 105,000 in OJT [80]. Just over 40 percent of the OJT openings (approximately 42,000) were for coupled training. It is not known what proportion, if any, of this number are in auto mechanic training programs.

In any case, the OJT auto mechanic training programs are, of necessity, very flexible. This means that the work-experience schedule is subject to the demands of the business that is conducting the training; subject matter (experience) is provided according to the kind and amount of work that is in progress at any given time. While there is a contractual obligation to cover the basics outlined in the agreement, there is also recognition that make-up of the work load will determine the practical extent to which a subject can be covered. Consequently, at least so far as the auto mechanic program is concerned, the OJT experience schedule is tentative at best.

The OJT experience schedules, as a rule, are not designed to produce a fully qualified mechanic, proficient in all aspects of automotive work. Rather, these programs tend to single out a specific system on the vehicle, such as brakes, or a specific kind of skill, such as front-end alignment. The intent of the program is to give the trainee an opportunity to develop a specific skill to the point where it is, in fact, a salable one.

Since the OJT program is based on the principle of learning by doing, it is essential to put the trainee in a situation in which he is performing the desired operations under the close supervision of an experienced worker. Consequently, a "buddy" system approach is frequently used. In other words, while there is a tentative list of operations that the trainee is expected to learn, the trainee is frequently paired with an experienced person who teaches the trainee as they work together on the task to which they have been assigned.

Because of the irregular nature of the training events that occur in the normal course of automotive service and repair, no detailed analysis, or course content type presentation of OJT programs, will be attempted in this study.

5.3.3. THE MANUFACTURERS'TRAINING PROGRAMS. The primary purpose of a manufacturer's product service training program is to influence the potential customer to purchase the manufacturer's product. In the case of the automobile, product reputation is greatly affected by the speed, quality and cost of the service and repair work available at a given dealership garage. Thus, it is extremely important to the manufacturer to assure that the mechanics employed by the dealership are competent and are proficient in the service and repair of the manufacturer's product.

Product familiarization and system specialization, therefore, are the primary objectives of the manufacturer's training program. Recent developments in understanding the underlying social and economic relationships in the American free enterprise system, however, have brought about a shift of emphasis in the manufacturers' programs. As a result, training is no longer offered exclusively to dealership personnel, and it is no longer limited strictly to product changes and specialized maintenance problems such as hydramatic transmissions or Delcotron electrical systems. It is no longer exclusively an updating operation, but includes training in the basics and fundamentals of automotive service, maintenance and repair.

Job Market Orientation. Manufacturer's training is oriented toward a captive job market. Access to the training has traditionally been through the dealership organization; only mechanics who were employed by a dealer were eligible to receive the training. Recently, however, the training has been made available to mechanics who are not on the dealership payroll and to inexperienced and untrained persons from entirely outside the corporation structure and the dealership organization. Training offered to men returning to civilian life from the military is one example; and the recruitment and training of the disadvantaged is another.

In any case, the manufacturer is able to offer extensive training programs because there is reasonable assurance that the benefits of the training will accrue, primarily, to the sponsoring manufacturer. The trainees, for the most part, come from the job market they are expected to serve, and return to it when the training is completed.

There are some difficulties in the system, however, since there is no built-in assurance that the trainee will remain in the employment of the sponsoring dealer. Dealers, therefore, are inclined to select for training only those mechanics who are expected to remain loyal; dealers are understandably reluctant to invest time and money in an employee who is likely to switch employers at a later date.

There is a very real element of risk in the training investment, from the dealers' standpoint, while the risk to the manufacturer is negligible. This is because unique applications of the laws of physics and the principles of mechanics gravitate toward each manufacturer's product line. The result is that there are Ford mechanics, Chevrolet mechanics, Plymouth mechanics, etc.; not because a Ford mechanic is unable or does not know how to work on a Chevrolet, but because he is accustomed to Ford's unique application of the principles and prefers to work with them.

Consequently, when the Ford mechanic moves to a new employer, he is most likely to take his Ford experience and Ford training to another Ford dealer. Thus, while the sponsoring dealer has lost his training investment, the sponsoring manufacturer has not; and no amount of argument can convince the loser that the investment comes back to him in the form of a newly hired mechanic from some other Ford dealership. The result is a constant contention in which the manufacturer urges more and more training upon a dealer who feels very strongly that he is damned if he does and damned if he doesn't. This is an underlying, frequently recognized, cause of friction between dealer and manufacturer.

Labor Force Involved. The labor force can be characterized as one that is chiefly concerned with upgrading. The participants, in general, are experienced mechanics who have already achieved a level of competence and stability that, in the opinion of the employer, warrants an additional investment in training. Where the participant is not a previously qualified mechanic, the employer must have confidence that the trainee possesses the mental, social and physical traits that indicate a reasonable degree of success in learning the automotive mechanic's trade.

Since this is basically an employed labor force, the objective it seeks for itself is not to gain entry to the trade, but to secure a more desirable job, i.e., better pay. This function is clearly recognized by the majority of the men in the trade, hence, the competition for assignment to a training course or session is usually keen. This allows the employer to direct training into those channels from which his business derives the greatest benefit. While it is to the employer's advantage to provide training for all of his mechanics, it is seldom possible to allow more than a handful of his men to participate in training at the same time; the nature of the business demands that a high proportion of the skilled mechanics be on the floor at all times.

Consequently, the men who are selected for training are likely to be those who can assimilate the new information and put it to use most quickly and effectively. Thus, the best mechanics tend to get the most training, while the less skillful, who most need the training, get the least. While skill and knowledge are widely distributed because of the size of the program, the real effect of the manufacturer's training is to concentrate the skill rather than to spread it.

Note that while these programs may significantly improve the quality of the automotive service and repair work performed in the dealership garages, they do not materially increase the size of the dealership mechanic population. Thus, even though they are highly beneficial, they are not particularly important from the standpoint of overcoming the presumed shortage of mechanics.

Sponsorship and Financial Support. The manufacturer and the dealer share responsibility for the sponsorship and financial support of the training programs. In general, the manufacturer develops and presents the training, and the dealer arranges for the mechanics to attend the training sessions. While the manufacturer bears the cost of developing the training materials, the dealer is sometimes required to purchase printed course materials and other teaching aids such as film strips and recordings. The cost of travel and per diem is born by either the dealer or the manufacturer, depending upon whether the teacher goes to the student or the student goes to the teacher.

Two systems of training are in general use; in one, the training is conducted in a central location; in the other, the training is conducted on the premises of the individual dealerships. In either case, the mechanic is temporarily removed from the work force at the dealer's expense, and the instructor conducts the training at the manufacturer's expense.

The two systems usually operate concurrently. An instructor may be conducting a brake adjustment, or front-end alignment session on the garage floor, while, at the same time, a mechanic may be off to the central training center to learn about transmission overhaul or emission control adjustments. In other words, the nature of the component or system and the task to be mastered determine how and where the instruction is to be given. Some tasks are better illustrated on the garage floor, and some are more effectively handled in the classroom or in the laboratory.

From the manufacturer's standpoint, every troublesome aspect of the vehicle must receive attention according to some system of priorities, and every mechanic in the work force must be updated as often as necessary, and as quickly as possible. From the dealer's standpoint, the weaknesses of his work force must be overcome according to some system of priorities, but the training cannot be allowed to interface with the operation of the business to the extent that it creates a jam on the garage floor and causes customer relations to deteriorate.

Consequently, a difficult scheduling problem arises in which the manufacturer and the dealer are basically at odds with each other, even though their ultimate objectives of improved customer service is the same. Thus, training sessions held on the dealer's premises tend to be short and are frequently staggered so that all of those who need the training may attend without having to completely shut down the operation of the garage. Where training is held in a distant center, the dealer must coordinate the planned work load with the training dates so that affected personnel are free to participate without creating a customer problem through over-scheduling of work.

Enrollments, Completions and Job Placements. Since the manufacturers' training programs consist primarily of numerous short courses, each aimed at a discrete problem, it is difficult to assemble meaningful enrollment and completion data. In addition, since the training is predominantly employee oriented, job placement data is irrelevant. As previously pointed out, the manufacturers' training programs basically do not add to the work force, but simply improve what already exists. Consequently, enrollment, completion and job placement data applicable to the manufacturers' training programs have not been gathered.

Training Courses: Content and Duration. The majority of the auto mechanic training that is provided by the manufacturer is directed toward the day-to-day automobile maintenance problems that occur in the dealership garages. These are usually short courses that vary from two or three hours to two or three days. Comprehensive courses in the fundamentals and theory of automotive mechanics are also offered. These courses may take from several weeks to several months. In addition, courses in higher education are available to mechanics who can qualify academically.

Programs on the higher level, such as those offered by the General Motors Technical Institute, lead to a degree, or associate degree, and ordinarily take two to four years. Since they are not really applicable to the mechanic training effort, however, they will not be considered in this report.

The comprehensive courses and specialities such as automatic transmission overhaul are ordinarily conducted in the manufacturer's own training facilities where specialized teaching aids are available. Equipment like hydraulic flow benches, cut-away engines, and front suspension mock-ups are very helpful, but are totally impractical to cart about from dealer to dealer. Hence, there is a need for a training facility in which lecture, demonstration and laboratory (shop) experience can be provided for the trainee.

An example of a manufacturer's auto mechanic training program is given in outline form in Table 54. While this particular example is from the Chrysler Motors Corporation Automotive Technician Training Program [92], the other manufacturers have approximately equivalent courses. Note that while the course content is about the same as that found in the average high school, post-secondary or MDTA program, the duration is much shorter. The manufacturer's training achieves a degree of concentration and intensity that would be unreasonable in any other setting, except, perhaps, in the military.

The short training courses, usually intended for use in the dealership, are frequently so designed that each training session becomes an increment in a larger course. Thus a 10-hour brake overhaul course may be made up of 5 two-hour sessions, each one of which is self contained, and may be used entirely independently to provide training on a specific item. In an imaginary example, the units might be: (1) master cylinder, (2) wheel cylinders, (3) brake shoes and expanders, (4) brake drums and (5) brake adjustments. Each one covers a specific problem area, but together they constitute a coherent study course for the whole brake system. Table 55 shows some examples of this type of course [93].

5.3.4. THE ARMED FORCES AUTO MECHANIC TRAINING PROGRAMS. If the military is to operate effectively, every individual in it must be prepared to properly execute every task that falls within the scope of his responsibility. Responsibility is carefully identified, therefore, and the individual is given appropriate training to assure that he is, in fact, competent to

TABLE 54. CHRYSLER MOTORS CORPORATION AUTOMOTIVE TECHNICIANS TRAINING PROGRAM CURRICULUM SCHEDULE OF RELATED TRAINING SUBJECTS [92]

On each subject, the basic fundamentals, theory, and operating principles of each unit will be thoroughly covered to permit a complete understanding by the trainee. The necessary components and special tools will be introduced and used as required. The following classroom curriculum is designed to permit a new trainee to enter a group virtually anytime during the 12-month cycle. Exceptions are Sessions 8 and 11, which are prerequisite to those sessions immediately following. TOTAL HOURS: 180.

Session No., Subject, Hrs.	Description
1. Brakes (15 hrs.)	Drum and disc-type service and repair; including wheel and master cylinders, and parking brake assemblies. Includes introduction to brake booster units.
2. Engines (15 hrs.)	Disassembly of typical engine, including service to all components: pistons, rings, valve mechanisms, connecting rod and main bearings, cooling and exhaust systems. Includes general overhaul procedures.
3. Electrical (15 hrs.)	Batteries and electrical applications. Service, repair and diagnosis of alternators, regulators, small electric motors and starters. Familiarization of body/electrical circuitry.
4. Engine Tune-up (15 hrs.)	Tune-ups and engine evaluation procedures, including complete fuel system and carburetion theory and tests. Crankcase ventilation system and anti-smog devices-use of engine testing equipment.
5. Suspension and Manual Steering (15 hrs.)	Study of front end geometry, wheel balance and manual gear assembly. Steering column service repair.
6. Power Steering (15 hrs.)	Repair, service and diagnostic procedures on all power steering gears and pumps.
7. Manual Clutch and Transmission (15 hrs.)	Disassembly and repair procedures on clutch assembly. Theory of clutch mechanisms. Three-and-four-speed transmission service and repair.
8. Automatic Transmission I (15 hrs.)	Disassembly, study and reassembly complete, including performance evaluation procedure on automatic transmissions and torque coverters.
9. Automatic Transmission II (15 hrs.)	Study of applied hydraulics, torque convertors, transmission controls and shift valve bodies.
10. Rear Axles (15 hrs.)	Disassembly and study of typical axle assemblies. All adjustment procedures will be shown and sure-grip axles introduces.
11. Air Conditioning and Ventilation (11.5 hrs.)	Theory of air conditioning, repair and service of systems. Trouble shooting and servicing all components.
12. Body Mechanisms (11 hrs.)	Alignment of doors, deck lids and hoods. Glass service and body sealing. Door and window mechanisms, including convertible tops.
Principles of Service Mgmt. II (4 hrs.)	Objectives of sound service management and its relation to the repair technician.

TABLE 55. EXAMPLES OF MANUFACTURERS' SHORT TRAINING COURSES [93]

Course Title	Course Hours	Course Cost ($)
Car Vacuum Hydraulic Brakes	10	64.81
Principles of Operation	6	
Diagnosis	2	
Overhaul and Major Repair	2	
Gasoline Engines	38	181.74
Principles of Operation	6	
Diagnosis, Adjustments and Light Repair	4	
Description, Operation and Overhaul	4	
Description, Operation and Overhaul	4	
Description, Operation and Overhaul	4	
Description, Operation and Overhaul	4	
Description, Operation and Overhaul	4	
Description, Operation and Overhaul	4	
Overhaul and Major Repairs	4	
Body	54	112.66
Water and Dust Leaks Diagnosis and Repair	8	
Glass Replacement	8	
Paint and Body Estimating	16	
Sheet Metal Repair	8	
Paint Repair	2	
Convertible Top Adjustment and Light Repair	4	
Vinyl Roof Repair and Replacement	4	
Color Matching Metallic Paints	4	
All Possible Car Courses	396	1,394.64
All Possible Truck Courses	232	549.46
All Possible Courses	628	1,944.10

perform the assigned duty. The result is a clearly defined division of labor and responsibility that has no real counterpart in civilian life, since responsibility in the military also carries with it a clearly defined and enforceable authority.

In terms of motor vehicle maintenance, the military division of labor means that tasks are assigned to a level of responsibility according to the frequency with which the task occurs, the knowledge and skill required to do the task, and the compatability of associated tasks and responsibilities. Thus a great many men are trained to execute the routine, simple tasks, while proportionately fewer and fewer are trained to do the less frequent and more complex tasks. The hierarchy of tasks conforms to the hierarchy of responsibility and authority.

Job Market Orientation. The personnel requirement of a military unit is defined in a table of organization, and the job market for a given occupational skill is satisfied by simply selecting and training enough men to fill the slots. It terms of automotive maintenance, the greatest need for personnel is at the lower skill level, where the bulk of the automotive service and repair work lies. Thus, the majority of the military training is directed toward that level, and the civilian job market which corresponds most closely to this is the gasoline service station or the routine service department of the garage.

Labor Force Involved. This study does not attempt a detailed analysis of the characteristics of the labor force arising from the military automotive training programs. It is assumed to be a relatively young population, and scores achieved on general aptitude and intelligence tests influence selection for training. It is considered an entry-level population in terms of mechanic skill, since it appears that military experience is chiefly concerned with automotive servicing and minor repair.

Sponsorship and Financial Support. Since these training programs are entirely under the control of the armed services, no discussion of sponsorship or financial support seems to be needed. Likewise, no effort was made to determine the cost of automotive mechanic training in the military services.

Enrollments, Completions and Job Placements. The Bedell study [26] shows that as of April 1963 21.6 percent of the employed auto mechanics had received auto mechanic training in the armed services prior to the study. There is no indication, however, of what proportion of that training derived from the World War II era, or of how many trained mechanics are produced annually by the armed services. In view of the unpredictable nature of the military as a source of supply, the 21.6 percent figure must be used with caution when assessing the impact of this source on the automotive service and repair industry.

Unpublished statistics compiled by the Department of Defense [94] show that in fiscal year 1968 there were 32,862 men who completed training in occupations listed under Department of Defense group 61, which includes automotive (general), track vehicles, and construction equipment. This classification includes all four branches of the service.

When this total is broken down according to length of course completed, however, the effect of the military training on the automotive service and repair industry is seen in a different perspective. Of the 32,862 completions, 24,575 involved courses of eight weeks duration or less; 8,107 were from courses of 9 to 14 weeks; and 180 completed courses of 21 to 29 weeks. It is assumed, therefore, that the majority of the training was in the area of service work and minor repair, and that relatively few highly qualified mechanics enter the civilian labor force from that source.

Training Courses: Content and Duration. Since military automotive training is concentrated in short courses that are largely service oriented, no attempt will be made in this study to detail and analyze the course content and hours of duration.

6. ANALYSIS AND EVALUATION OF THE FINDINGS

The intention of this study is to determine whether current automotive mechanic training programs provide adequate exposure to the essential knowledge and skills required to properly service, maintain and repair motor vehicles. Having gathered a quantity of information, the following analysis and evaluation will eliminate from further consideration the irrelevant and the non-essential and will permit the selection of the tasks, establishments, labor force and training programs that constitute the core of the automotive mechanic training effort.

6.1 THE REPAIR PROBLEM AND THE REPAIR TASKS

Aside from the constantly increasing size of the vehicle population, the crux of the repair problem revolves around the normal wear and degradation of the vehicle. Vastly improved component life and reliability have been achieved through advanced engineering and manufacturing techniques. Yet parts continue to deteriorate and wear out. Although components exhibit greater durability, component life is controlled more by hours of use or miles of service than by calendar age. Improved highways, higher average driving speeds and increased usage of the vehicle compress the life of the component into a shorter time span, thus off-setting, to a great extent, the gains in component durability and reliability.

In reviewing the service, maintenance and repair of motor vehicles, it is found that an almost endless combination of discrete tasks is involved. Therefore, the vehicle is divided into its component systems, and the discrete tasks are grouped under these headings for the sake of uniformity, convenience, and practicality. Table 1,2, and 3 provide a comprehensive listing of tasks, and Table 8 provides an outline of the major task groups.

It is noted that the body of service, maintenance and repair tasks changes as innovations appear and as previously introduced items disappear. Innovations in general, however, are simply new applications of old principles. Consequently , the updating of the mechanic is more a matter of familiarization rather than of new learning. While there is a constantly shifting body of knowledge, the fundamentals with which the mechanic works do not change. If this were not so, it is doubtful that any mechanic could keep pace with the constant change in the detail of the automobile.

6.2 REPAIR TASKS AND ESTABLISHMENTS

This study assumes that there are a finite number of tasks that are performed in the service, maintenance and repair of motor vehicles. It also assumes that every establishment limits its activities to a specific assortment of tasks, and that it defines its operation as general or special according to the scope of the work it is willing to perform. The study further assumes that there is an identifiable core of tasks that constitute the occupation of automotive mechanic, and that an establishment does not require the services of an automotive mechanic unless the majority of those tasks are included in the scope of its work.

By observing the tasks performed, it is possible to determine which establishments need an automotive mechanic and thereby to identify those establishments that exert a significant influence on the character of the formal automotive mechanic training programs. In this way, several kinds of automotive service and repair establishments can be eliminated from further consideration in this study because they require only limited application of a mechanic's occupational skill, or because they deal with a level of service that does not require the mechanic level of skill.

Table 56 lists the various types of service and repair establishments and show the basic categories of tasks with which each

TABLE 56. REPAIR TASKS AND REPAIR ESTABLISHMENTS

	Electrical System	Starter	Generator	Windshield Wiper and Washer	Lights and Warning System	Accessories and Instruments	Ignition	Fuel System	Engines	Rebuild	Valves	Lubrication	Crankcase Ventilation	Exhaust System	Cooling System	Transmissions	Clutch	Conventional	Automatic	Drive Train	Rear Axle	Differential	Brake System	Shock Absorbers and Suspension System	Steering	Chassis and Lubrication	Tire and Wheel Balance	Front-end Alignment	Tune-up	Air Conditioning	Body and Paint Repair	Interior Repair
Dealership Garages	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Independent Garages	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Gasoline Stations	x	x	x	x	x		x	x	x			x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x			
High-Volume Shops	x	x	x	x	x		x	x				x	x	x	x		x			x	x		x	x	x	x	x	x	x			
Diagnostic Centers	x	x	x				x	x					x	x	x								x		x		x	x	x			
Speciality Shops:																																
Radiator															x																	
Front-end Alignment																								x	x	x	x	x				
Tire Retreading																											x					
Starter-Generator Repair	x	x	x		x	x	x																						x			
Upholstering & Convertible Shops																																x
Brake																							x	x								
Collision														x	x					x			x	x	x	x	x	x			x	x
Transmission																x	x	x	x													
Muffler														x										x								
Rebuilders:																																
Engine								x		x	x	x	x		x														x			
Transmission																x	x	x	x		x	x										
Accessories		x	x	x				x							x		x					x							x	x		
Self-Employed	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tire, Battery and Accessories	x	x	x			x	x	x						x	x								x		x		x		x			
Fleet Operators	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			

is concerned. It can be seen from this table that some establishments perform the majority of tasks and others do not. The specialty shops, the rebuilders, and the diagnostic centers do not; consequently, they are eliminated from further consideration in this study.

The high volume shops, the tire, battery, and accessory shops, and the self-employed mechanic are all qualified to participate in the full range of service and repair tasks, but they do not ordinarily do so. Most of these establishments perform only those tasks that produce a high rate of return on a minimum investment in time, expendable materials, equipment, and facilities. In addition, these operations account for a relatively small share of the total automotive service and repair trade (see Table 10). Consequently, they are eliminated from further study.

The fleet operators are also eliminated. While they generally perform the full range of mechanic tasks, they employ a relatively small proportion of the total automotive mechanic population. In addition, where trucks and buses are involved, the tasks require a different body of knowledge, a different array of skills, and they are embedded in a different physical environment.

Having eliminated the speciality shops, rebuilders, diagnostic centers, high volume shops, TBA shops, the self-employed and the fleet operators, three major groups of general service and repair establishments remain. They are the dealership garages, the independent repair shops and the gasoline service stations. They are the three major employers of automotive mechanics, as shown in Table 23.

Table 11 indicates that these three groups are evenly matched in the scope of work performed, although there are differences in the extent to which tasks are pursued. The gasoline service stations, as might be expected, predominate in areas such as lubrication and minor maintenance, while the independent shops do the largest share of in-house major overhaul work such as engine rebuilding, cylinder boring, and valve overhaul. The dealership garages apparently exceed the others only in the highly product-oriented tasks such as automatic transmission overhaul.

These three groups are evenly matched in terms of service, maintenance and repair equipment on hand. Table 12 also indicates that these three kinds of establishments perform about the same range of tasks, although there is somewhat greater emphasis on servicing equipment, such as air compressors, hoists, battery chargers, etc., in the service stations.

Although the dealerships, independents, and gasoline service stations participate more or less equally, in terms of the scope of the tasks performed, each had a relatively exclusive clientele until very recently. New car work, regardless of cause, was alloted to the dealership garage, under the traditional pattern of distribution. Cars more than two or three years old, and the preponderance of major overhaul work, went to the independents. The gasoline service stations performed most of the service work, particularly on the older cars, and took up the slack in the maintenance and repair work, particularly the minor maintenance.

This pattern has changed, however, under the pressure of an expanding vehicle population. Warranty work, once the exclusive domain of the dealership, is being forced into the independent repair shops and the gasoline service stations because of the extended coverage and the increased volume of cars. General dissatisfaction with the customary channels of service and repair have induced the motoring public to seek relief elsewhere. The result is a more even distribution of the work as well as a more even distribution of the tasks.

The result of these changes is also reflected in the characteristics of the personnel employed by these establishments. While differences in total personnel requirement have not changed, the distribution of mechanics is tied to the distribution of the work, and, consequently, there is an increased demand and greater competition for skilled mechanics.

The average hourly wage of the automotive mechanic remains low, however, in comparison to other skilled trades (see Table 16). Among all of the businesses that employ automotive mechanics, those in the retail trade pay the lowest. The average hourly rate for auto mechanics engaged in the retail trade was \$3.21 in the metropolitan areas in 1968, and it varied from \$2.86 in the south to \$3.67 in the west (see Table 17). Wages also vary greatly according to the size of the establishment and the legal form of its organization. Tables 18 and 19 illustrate that the larger shops and the corporations pay better wages, in general, than do the small places and individual proprietorships; the dealerships, in general, pay better than the independent repair shops.

Working conditions, also depend somewhat upon the size and organizational form of the establishment. The distribution of establishments, according to sales size and form of ownership, indicates that most shops are small ones (see Table 13). This study assumes that small shops tend to be less desirable places in which to work because of the economic inability of the management to provide a desirable working environment.

While the criteria for entry-level employment as an automotive mechanic probably also vary between the dealership, the independent repair shop and the gasoline service station, the existing data do not relate to this point. Thus assumptions concerning the relationships between entry level employment and type of establishment must be tentative.

The review of the literature indicates that the primary criterion for entry into the auto mechanic's occupation is previous work experience. Yet it is noted that the automotive mechanic population is significantly younger than other similarly skilled populations and, for that matter, the total employed male labor force (see Table 30 and Figure 2). While this seems to imply a conflict of facts, an explanation may be found in some of the other characteristics of the population.

According to Table 32, over 70 percent of the auto mechanics failed to complete high school. Thus it is reasoned that many young men gain entry into the trade through work experience in a related occupation in which neither youth nor lack of experience are a deterrent to employment. Occupations such as gasoline station attendant or casual laborer in an automotive repair shop or garage are examples of such jobs that are readily available to the high school drop-out.

Since it is possible, even without formal training, to master the auto mechanic's trade within two or three years, it is possible, particularly where there is close occupational association, to qualify for an entry-level mechanic's job in a relatively short time. Thus it is not surprising to find a high percentage of young men in the trade. This assumption is supported by Table 35, which shows that 61.9 percent of all automotive mechanics learned their trade through casual methods, i.e., without benefit of formal training.

The foregoing suggests that, in the case of the automotive mechanic, there is a difference between "market demand" and "felt need". There is a very large market for automotive mechanics and, since the demand continuously exceeds the supply, a real shortage exists. The review of the literature reveals, however, that the need is actually for highly skilled mechanics. Consequently, while the demand is great, it is a specific one, and there is almost no demand at all for the inexperienced graduates of the high school auto mechanic vocational training programs.

The findings indicate that about 41,000 men are needed annually to offset normal attrition and to expand the auto mechanic population to the projected 1975 figure. The findings also suggest that existing auto mechanic training programs should be able to satisfy this need. The estimated annual enrollments of all auto mechanic training programs combined is about 136,600 (excluding military, manufacturers, and commercial trade schools), which should produce an annual output of about 98,000 trainees when appropriate allowances are made for programs requiring more than one year to complete. On this basis, more men receive training than are needed by the industry.

Table 41 shows that about 72 percent of the high school auto mechanic course completers are available for employment and that about 68 percent of that number are employed in the trade or in related occupations. If these percentages are applied to the total number of completers reported in the findings (27,278), it is found that 19,640 are available for employment, and 13,355 are employed in the trade or a related occupation. Duis shows [71] that total completions for secondary and post-secondary atuo mechanics (Code 17.0302) are 26,570, of which 19,688 (74.0%) are estimated to be placed in the trade or a related field.

The completion and placement statistics suggest that about 60 out of 100 completers are available for employment, and that about 45 of those (75%) find employment in the field for which they were trained. It is noted that it is therefore necessary to train 100,000 mechanics annually in order to add 45,000 trained mechanics to the labor force each year, which is barely enough to meet the current needs of the automotive service and repair industry. Thus it appears that either the system of selection for vocational training is not properly geared to the real world needs of the student and the employer, or the student is inadequately prepared to decide upon a career when the vocational training choice is made. In either case, the result is an inefficient way of producing trained personnel for the industry.

The meaning of the terms "in the trade" and "related occupations" are vague at best and should not be interpreted to mean that the graduate is hired as a mechanic. The majority of garage men with whom this problem was discussed indicated that youths who are newly graduated from high school auto mechanic vocational training courses are too immature and too inexperienced to be hired as auto mechanics. They are, in general, used in the same kinds of positions offered to the untrained high school dropout, i.e., greasers, helpers, handymen, etc. This may explain why so many of those who take the training fail to pursue the trade.

6.3 LABOR FORCE IN RELATION TO TASKS AND ESTABLISHMENTS

It is found that there are a number of categories of workers within the industry who do not use, and do not need, the full range of knowledge and skills required of the mechanic. Body repairmen, for example, must acquire a highly refined skill in their line of work, but they are, categorically, never involved in the other aspects of automotive service and repair. Consequently, they can be eliminated from further consideration for the purpose of this study. Engine rebuilders, upholsterers, painters, glazers, diagnosticians, front-end men, brake bonders, and many others who perform a limited range of tasks are likewise eliminated.

In other words, this study is concerned with the all-around mechanics, the men who are able to perform more or less the complete range of tasks involved in the service, maintenance and repair of motor vehicles, and who staff the establishments that offer more or less the complete range of services. This relationship of men to establishments is shown in Table 57, in which the capability level of the mechanic is related to the scope of service in terms of establishment type.

The Dictionary of Occupational Titles [8] describes the mechanic both as automobile mechanic and as automobile service mechanic. These descriptions are very nearly the same; somewhat more weight is given to machinist skills in the first, and to automobile servicing skills in the second.

An automotive mechanic is identified in this study as an individual who is able to satisfactorily perform the majority

TABLE 57. THE EXTENT OF ALL-PURPOSE CAPABILITY IN RELATION TO ESTABLISHMENT TYPE

Extent of Capability	High Volume Shops	Dealer-ship Garages	Independent Repair Shops	Gasoline Service Stations	Specialty Shops	Diagnostic Centers	Fleet Operators	Self Employed
Maximum All Purpose		x	x	x			x	
Maximum Special Purpose					x	x		
Moderate All Purpose	x					x		
Moderate Special Purpose	x	x	x	x				
Minimum All Purpose					x			x
Minimum Special Purpose							x	x

of the service, maintenance and repair tasks required for the continuing operation of a motor vehicle. The automotive mechanic is not only proficient at removing and replacing parts, which constitutes the bulk of his work, but he is able to identify faults and malfunctions, interpret symptoms, determine the appropriate corrective action and perform the necessary work in such a manner that it is technically and economically acceptable to the customer and financially profitable to himself. While the mechanic is not expected to be proficient in the execution of every task that arises in the course of automotive service, maintenance and repair, it is assumed that he is knowledgeable enough to recognize his personal limitations and to seek assistance when necessary.

This individual is able to perform a wide range of tasks with competence and consequently, is most frequently employed by those establishments that offer a wide range of service, i.e., the dealership garages, the independent repair shops, and the gasoline service stations in which more than specialized or simple automotive servicing is offered.

The findings indicate that about 1.5 million men are engaged in the service and repair of motor vehicles. About one half of this number (770,000) are classified as mechanics, according to the Bureau of Labor Statistics, and the remainder are service station attendants, lube men, car washers, etc. About two thirds of the mechanics are employed by the dealership garages, the independent repair shops, and the service stations.

Present indications are that the maintenance technology of the automobile will change and the skills needed to compete successfully in the automotive service and repair industry will also change. The nature of the training will gradually accomodate the new product and new trade characteristics. The CAMPS forecast indicates that the shortage of auto mechanics will continue into the foreseeable future, and that other occupations are likely to create an increasing drain on the population that has historically been the source of the rank and file auto mechanic. Ample manpower will be available in spite of the increasing demand, however, but the new mechanics may come from a different segment of the population.

The present practice of depending upon previous work experience as the primary criterion for employment, even for the entry-level mechanic, may also change. Note that the low average number of years of school completed and the high percentage of auto mechanics with no formal mechanic training seem to indicate a high incidence of school drop-outs in the trade. This being the case , some question is raised concerning the practicality of concentrating the vocational training in the last two years (11th and 12th grades) of high school, since many of those who become auto mechanics have already dropped out. Consequently, there is reason to believe that the utilization of a sociologically and educationally depressed sub-population could become a decisive factor in meeting the skill shortage of the auto repair industry in the future, given appropriate changes in the present training and employment philosophy.

6.4 TRAINING SYSTEMS VERSUS TASKS, ESTABLISHMENTS, AND LABOR FORCE

The purpose of this study, as previously stated, is to discover whether current training programs adequately prepare the automotive mechanic to properly service, maintain and repair the motor vehicle. Since the emphasis is on preparation, the study is necessarily focused on pre-employment training, even though all aspects of the training systems are included. The study is based on an initial assumption that all training systems do not produce equally competent mechanics who are prepared to participate in all phases of the automotive service and repair activity.

The assumption is also made that some training programs more adequately serve the industry, in terms of pre-employment training, than do others. Consequently, only those that produce graduates with maximum utility to the industry will be selected for further consideration. Table 58 shows the scope of the entry-level skills and the training systems that produce the greatest range of entry-level people.

The non-system, although it produces the greatest number of mechanics, can only produce the minimum amount of all-purpose skill or special purpose skill at the entry level. Since the non-system always relates to the previously untrained, it must always start with those who have a minumum of all-purpose capability. Thus, the non-system is eliminated from further consideration.

The secondary school vocational programs produce a very wide range of both all-purpose and special purpose capability. Some students are highly trained, highly competent mechanics upon graduation, and many of the more skillful have acquired a great deal of specialized capability in the process. Consequently, the high school vocational programs produce a relatively complete range of capability, from those who are entirely unable to qualify for employment to those who are sought after by the local establishments. Therefore, this training system will be retained for further consideration.

Post-secondary schools, in general, produce a relatively highly skilled group who are not ordinarily required to compete for jobs; those who successfully complete the course are quickly absorbed into the industry, frequently in better than entry-level jobs. Since relatively few are trained this way, these training programs are not considered a major source of entry-level personnel.

The adult education programs are predominantly up-grading operations, and, as such, they do not constitute an important source of entry-level people. While many of the adult education programs are of the pre-employment kind, these people tend to have had previous work experience; hence even where they are breaking into the auto mechanic trade, they do not compete for these positions

TABLE 58. THE RANGE OF ENTRY-LEVEL SKILLS PRODUCED BY THE VARIOUS TRAINING SYSTEMS

Type of Training System	Kinds of Entry Level Skills Produced: ALL-PURPOSE SKILL Maximum	Nominal	Minimum	SPECIAL PURPOSE SKILL Maximum	Nominal	Minimum
Non-System			X			X
Secondary Vocational	X	X	X	X	X	X
Post-Secondary	X			X		
Adult Education		X	X			X
MDTA Institutional	X	X	X	X	X	X
Commercial Trade School	X			X		
Apprenticeship	X				X	
MDTA OJT		X	X			X
Manufacturers			X			X
Armed Forces			X			X

on the same level with the newly trained, inexperienced worker. Therefore, these programs are also eliminated from further consideration.

While the MDTA institutional programs are basically intended as entry-level training, the course outlines frequently include related materials that are added specifically for the purpose of assisting the trainee to progress beyond the entry-level classification. In practice, however, many of the completers are able to achieve only minimum qualification for entry-level employment, although others move readily into a mechanic's job. Although this training system is an important source of entry-level people, it produces a relatively small number of completers compared to the public high school vocational programs. For this reason, the program is not retained for further consideration even though it produces the complete range of all-purpose and special purpose capability.

The commercial trade schools and the apprenticeship programs do not, in general, produce entry-level people. The trade school completer is a relatively competent operator by the time the training is completed. This is due partly to the selection process that brings highly motivated students to the school or the program and partly to the intensity of the training received. In either case, trade school completers and apprentices are not typically entry-level workers. Therefore, these training systems will not be included for further consideration.

The MDTA on-the-job programs are work oriented, as the name implies, and, in general, they deal with entry-level mechanic skills. They do not ordinarily provide for the comprehensive and detailed study of the mechanic trade, however, but tend to deal with important fragments of the occupation item by item. Thus, while they serve a very important function in providing the individual with a salable skill, they do not produce auto mechanics, per se, and are therefore eliminated from further consideration.

The manufacturers' training courses are not intended as employment preparation systems; the primary objective of these programs is familiarization and competency improvement. Since they are not an important source of entry-level mechanics, they are not considered further.

The Armed Forces training is highly specialized since its purpose is to maintain a specified complement of workers who are competent in specific areas of automotive service, maintenance or repair. These programs do not train entry-level people but rather people who are able to function completely in their assigned duty or particular job. This source is also eliminated from further consideration.

It is concluded that two automotive mechanic training systems are able to supply more or less the total range of entry-level all-purpose and special purpose personnel. These are the high school automotive mechanic vocational training programs and the MDTA institutional automotive mechanic training programs. Both of these systems come under the auspices of the U.S. Department of Health, Education and Welfare, and the U.S. Office of Education. Both are available, in general, to those who wish to qualify as entry-level auto mechanics.

It is further concluded, however, that the high school vocational training programs are the more important, since the number of enrollments in the high school auto mechanic courses (61,821) far exceeds the enrollments in the MDTA institutional courses (9,940). Consequently, only the secondary school automotive mechanic vocational training programs are retained for further consideration.

6.5 THE APPLICABILITY OF THE STANDARD TRAINING COURSE GUIDES

The tasks that constitute the work of the automotive mechanic are identified in Table 56. It is found that the total range of these tasks is performed in the dealership garages, the independent repair shops and the gasoline service stations. It is also found that the trainee population (labor force) to which the bulk of pre-employment auto mechanic training is directed consists of the students enrolled in the public high school automotive mechanic vocational training programs. Consequently, the evaluation of the current training practices derives primarily from the public high school vocational training system.

It was found that while the course outlines used by the individual schools vary widely in content and duration, the guides that were selected as standards with national applicability adequately cover the skills needed and are current. It is seen from Table 44 that the course content offered in the three criterion courses adequately encompasses the tasks listed in the flat rate manual (Table 1) and the manufacturer's manual (Talbe 3). They are also compatible with the range of repair tasks shown in Table 4 and the safety-related items listed in Table 7. In addition, these course guides include the repair, maintenance and service task categories listed in Table 8.

7. CONCLUSIONS

An evaluation of the current automotive mechanic training programs was performed by identifying: (1) the tasks associated with the service, maintenance and repair of motor vehicles; (2) the establishments that comprise the job market in which the bulk of this work is done; (3) the labor force that supplies the largest proportion of the formally trained entry-level personnel; and (4) the training program most likely to satisfy the overall needs of the industry for trained entry-level automotive mechanics. The efficacy of the current training programs was determined by selecting a suitable criterion course guide and comparing the tasks and skills implicit in it with the tasks and skills found in the industry. The following conclusions result from this analysis:

(1) While automotive service and repair tasks are performed by a number of kinds of businesses, it is the dealership garages, the independent repair shops and the gasoline service stations that do the bulk of this work and employ the bulk of the automotive mechanics.

(2) Out-of-school youths, both graduates and drop-outs, constitute the primary labor supply of entry-level automotive service and repair personnel.

(3) Although the majority of employed automotive mechanics have not experienced pre-employment auto mechanic training, the high school vocational training programs are the major source of formal pre-employment training for automotive service and repair personnel, including mechanics.

(4) The course guides that were developed by the AMA and the U.S. Office of Education and were selected by this study as criterion courses for auto mechanic training have national applicability, are current, complete, and satisfactory.

(5) The criterion course guides should be reviewed periodically and up-dated as necessary to accomodate changes in the social, technical, and legal environment.

(6) A bona fide shortage of automotive mechanics exists, but it is the highly skilled, experienced mechanics who are in demand; the demand for the inexperienced graduates of the high school auto mechanic vocational training programs is relatively light.

(7) The output of the existing high school auto mechanic vocational training programs exceeds the market demand for the graduates of those programs.

(8) The present system of selection for vocational training in the high school is inappropriate and leads to the inefficient use of the training capability since less than one half of the trainees are employed either in the trade for which they were trained or in a related occupation upon completion of the training.

8. RECOMMENDATIONS FOR FURTHER RESEARCH

Although this study shows that the selected auto mechanic training course guides are satisfactory, it does not indicate which is the most appropriate system for training automotive mechanics. Since the available data do not provide sufficient information upon which to base such an evaluation, it is recommended that a study be made which will include the following:

(1) An extensive survey of the automotive service, maintenance and repair industry that will:

  (a) Reveal the education, occupational training and previous work experience of the employed entry-level automotive mechanics, service personnel, and repairmen.

  (b) Identify the criteria for employment as entry-level automotive mechanic, service worker and repairmen.

  (c) Describe the rationale upon which the above criteria are based.

(2) An extensive survey of the entry-level employees in other kinds of businesses that will:

   (a) Reveal the education, occupational training and previous work experience of the entry-level employee.
   (b) Show how they obtained the present job, and why they elected that particular occupation.
   (c) Indicate whether they would or would not accept employement as an automotive mechanic and why.

(3) A cost/effectiveness evaluation of all existing automotive mechanic pre-occupational training systems in order to determine:

   (a) Which system constitutes the most efficient pre-employment training of automotive mechanics.
   (b) Whether an optimum cost per trainee can be identified for the pre-employment training of automotive mechanics.

Based on the above, it may then be possible to construct a training-employment system that will: (1) provide a realistic level of auto mechanic pre-employment training; (2) produce an adequate supply of trained entry-level automotive service and repair personnel; and (3) give reasonable assurance to the enrollee that a competitive wage and a challenging career are available at the entry-level in the automotive service and repair industry.

It is also recommended that follow-up studies be broadened to include the high school drop-out. In view of the very poor high school attendance record of the existing population of auto mechanics, and the large percentage of auto mechanics who did not have formal pre-employment training, it is perhaps more important to study the drop-out than the graduate. It is also important, in regard to follow-up studies to define the terms "in the trade" and "related occupations", to name the related occupations, and to show how many of the followed students are employed in each.

It is also recommended that enrollment, completion and placement data be compiled for the automotive mechanic training programs conducted in the post-secondary schools, the commercial trade schools and the adult education programs. The current lack of information about these training institutions makes it difficult to properly evaluate the total training system.

It is also recommended that a study be made of the influence of motor vehicle codes and safety regulations on the training and competency of automotive mechanics. Along the same lines, the requirement of a PMVI-oriented service and repair industry should be examined to determine how well current employment and training practices satisfy this need. The rapidly developing diagnostic technology and the expanding "remove and replace" maintenance technique should be included in the investigation.

Finally, it is recommended that continuous evaluation of automotive mechanic training and employment practices be conducted. The emerging realignment of social, political, economic and technical forces will result in a new population of automotive service and repair personnel and will produce a new environment in which to work. Thus, in order to avoid shortages of adequately trained automotive mechanics, significant changes should be anticipated so that appropriate adjustments to the training-employment system can be initiated before the need reaches critical proportions. In view of the preceding, the criterion course guides should be periodically reviewed and adjusted accordingly. In regard to existing conditions, it is recognized that many of the present high school vocational training programs should be improved. It is particularly noted that where it is necessary to restrict course length it is desireable to reduce proportionately each unit of the course rather than to eliminate one or more entire units. It is suggested, therefore, that the criterion course guides be followed more closely in setting up and in approving high school automotive mechanic vocational training programs.

Appendices

APPENDIX A: MEDIAN AGE AND SCHOOL COMPLETION

From the data provided by the Bureau of the Census on the age distribution of automotive mechanics (see Table 30), it was not readily apparent that the difference in the median age of automotive mechanics and the median age of the other selected skilled trades and the total male labor force was indeed statistically significant, i.e., not due to chance. It was decided to test for this significance by a method described by McNemar [67].

The census data appeared in a form essentially similar to that of Table 30 except that numbers were given instead of percentages. The percentages were calculated and the midpoint of each age interval was determined by adding the beginning age of the interval to the terminal age of the interval and dividing by two. Thus the midpoint of the first vertical column of Table 30, which corresponds to the age interval of 14 to 19 years would be

$$\frac{14.0 + 19.0}{2}$$

or 16.5.

An "arbitrary origin", defined as the midpoint of the age interval containing the largest number of people, was chosen for each occupation as well as for the total male labor force. For example, the arbitrary origin for automotive mechanic occupation is 39.5 or the midpoint of the 35 to 44 years interval. A difference score, d, was derived by subtracting the midpoints of the various age intervals from the arbitrary origin. The percent in each age interval was given the designation f. Then fd and fd^2 were calculated for each interval. The sum of $f(\Sigma f)$, $fd(\Sigma fd)$, and $fd^2(\Sigma fd^2)$ was found for each occupation and for the total male labor force and was used to calculate the standard deviation, S, with the formula

$$S = \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left(\frac{\Sigma fd}{\Sigma f}\right)^2}$$

for each occupation. The formula

$$S_{mdn} = \frac{1.253S}{\sqrt{N}}$$

was then used to find the standard error of the median, Smdn. N was defined as 5 percent of the total number of people in the occupation since the data was based on a 5 percent sample.

To test significance of difference between any two median ages, the formula

$$Z = \frac{|mdn_1 - mdn_2|}{S_{mdn_1 - mdn_2}}$$

was used. $Smdn_1 - mdn_2$ or the standard error of the difference was defined as

$$S_{mdn_1 - mdn_2} = \sqrt{S^2_{mdn_1} + S^2_{mdn_2}}$$

The respective medians of the various occupations were defined as mdn_1 and mdn_2. A Z-score of 23.92 was obtained for the comparison of the median ages of automotive mechanics and the total male labor force.

This comparison was made first since the difference between the median age of automotive mechanics and the median age of the total male labor force was the smallest of all the occupations examined, so if this difference was highly significant, then all the other differences would also be highly significant.

The Z-score of the difference was then converted into a significance of difference using a table provided by McNemar. This indicated that the difference was significant far beyond the 0.01 level.

Since these operations are quite lengthy and time consuming, it was decided to use the computer facilities of The University of Michigan. The University's IBM 360/67 computer was used to carry out similar computations for mean number of hours worked per week (Table 29).

A program was devised using Pit Interpretive Language (PIL). This language has the advantage of giving the user a conversational link with the computer, thus enabling him to follow and direct the computations step by step. However, PIL does not provide for storing the program for future use. Thus, the computer "forgets" the program, data and results once execution of the program is terminated. The program may be summarized as follows:

```
1.1     For I = 1 to 7:  Do Part 2
2.05    Demand SF(I), SFD(I), SFD2(I), N(I), M(I)
2.1     Set SD(1) - SQRT of (SFD2(I)/SF(I)-(SFD(I)/SF(I)**2)
2.2     Set SM(I)=*SD(I)/SQRT of (N(I))
3.1     For L = 1 to 6; Do Part 4
4.1     Set X(L)=SQRT of ((SM(L)**2)+(SM(L+1)**2))
4.2     Set Z(L)=|M(1)-M(1+L) |/X(L)
4.3     Type X(L), Z(L):  Do Part 1
```

Step 1.1 defines the subscript I. This subscript is used to identify the data from each of the seven populations (occupations) that were used in the comparison. Step 2.2's function is primarily one of convenience for the user. The computer will at this point ask for the values of SF(1-7), SFD(1-7, etc. These values correspond to the ΣS, ΣFD, etc., of the original formula. Steps 2.1 and 2.2 give the formula for the standard deviation and the standard error of the mean respectively. The omission of a factor of 1.253 at step 2.2 should be noted. This changes the formula from one that determines the standard error of the median to the standard error of the mean. Step 3.1 defines the new subscript L. This identifies the comparison that is being performed. Since automotive mechanics were compared to five other occupations as well as to the total male labor force, there are six possible comparisons in all. Steps 4.1 and 4.2 give the formulae necessary for the comparison, and step 4.3 asks that the results be typed out. The last line gives the computer the command to carry out the calculations.

The same type of calculations were carried out for the data which appears in condensed form in Table 32. In addition, a second test derived from McNemar was made to check for significant differences in the proportions of each population completing the various grade levels. First, the overall proportion, p_c, was determined using the formula

$$p_c = \frac{p_1 N_1 + p_2 N_2}{N_1 \quad N_2}$$

N is again defined as five percent of the people in an occupation with subscripts being used for reference purposes. The proportion of the first occupation (expressed as a decimal fraction) is defined as p_1. So if automotive mechanics with less than eight years of elementary school are compared to tool and die makers with less than eight years of elementary school, p_1 would equal 0.199, N_1 would equal 35,141, p_2 would equal 0.082, and N_2 would equal 9,245. The standard error of the difference between two proportions ($S_{D_{p(i)}}$) was then found by using the formula

$$\sqrt{p_c q_c \left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

where q_c equal $1-p_c$. The Z-score was then calculated with the formula

$$Z = \frac{|p_1 - p_2|}{S_{D_{p(i)}}}$$

This Z-score was then converted into a significance figure again using a table provided by McNemar.

Because of the numerous calculations to be performed, the previously described computing facilities were used. The program, using PIL, is summarized as follows:

```
1.1    For i = 2 to 7: Do Part $2_1$
2.05   Demand p(i)
2.1    Set $p_1 = (p(1) * N_1 + p(i) * N(i))/N_1 + N_{(i)})$.
2.2    Set $q = 1 - p_1$.
2.3    Set $s =$ SQRT of $(p_1 * q * (1/N_1 + 1/N_{(i)}))$
2.4    Set $z = |p(1) - p_{(i)}|/s$.
2.5    Type q, s, z.
```

Using these Z-scores, significance figures could then be determined using the table provided by McNemar.

The same test was applied to the data presented in Table 31.

APPENDIX B: COST OF AUTOMOTIVE MECHANIC TRAINING PROGRAMS UNDER THE MANPOWER DEVELOPMENT AND TRAINING ACT

The following data are from the annual reports on the MDTA by the Secretary of Health, Education and Welfare to the Congress. They were extracted from the reports of 1963 through 1969 by Safety Technical Manpower Division, Office of Safety Manpower Development.

AUTO MECHANIC TRAINING: REFERENCE

Manpower Development and Training Act
Report of the Secretary of Health, Education and Welfare to the Congress

1. ___________/OE-80027 2/28/63
   Training Activities Under the Manpower Development and Training Act

2. FS 1.2:ED8/OE-87030 4/1/64
   Education and Training: Key to Development of Human Resources

3. FS 1.26:965/________ 4/1/65
   Education and Training: The Bridge Between Man and His Work

4. FS 1.26:966/________ 3/31/66
   Education and Training: Passport to Opportunity

5. FS 5.287:87020/OE-87020 1967
   Education and Training: Expanding the Choices

6. FS 5.287:87020-68/OE-87020-68 April 1968
   Education and Training: Learning for Jobs

7. FS 5.287:87020-69/OE-87020-69 April 1969
   Education and Training: A Chance To Advance

Auto Mechanics

(1) No references

(2) P8 1963 Motor vehicle mechanic 4,487 total — 4,486 male, 1 female

As of August 30, 1963

P16 Length of auto mechanic courses:

Shortest course	16 weeks	480 hours
Longest course	52 weeks	2,080 hours
Most frequent length	52 weeks	1,440 hours
Average length	45 weeks	1,382 hours

Number of projects sampled - 128

P23 Budgeted Cost FY 1964

Number of trainees	2,101
Operating costs	$1,573,580
Capital outlay	606,951
Total	2,180,531

Capital outlay as percentage of total costs - 28

Average cost per trainee based on:
operating costs - $ 749
total costs - 1,038

P47 Cumulative July 1, 1962 to September 30, 1963

	Projects	Trainees
Automatic transmission repairman	5	120
Automobile mechanic		
apprentice	1	14
auto transmission	4	65
auto service	1	17
Automobile mechanic	151	3,673
preapprentice	2	31
service station	4	77
transmission	1	12
truck	4	61
tuneup	1	22
tuneup specialist	1	15
wheel alignment and repair	1	15
metal	1	15
Automobile service station attendant		
mechanic	6	197
technician	3	96
Automotive air conditioning installation and repairman	1	15
Automotive mechanic	3	80

(3) P15 Numbers of Trainees, October 31, 1964, Cumulative

Automobile mechanic	9,167
Automobile service station attendant	2,939

P26 Budgeted and Final Costs 1962-64

Based on Sample of 700 Completed Projects

Auto Mechanics - Average Length of Course - 20 weeks

	Budgeted	Final Costs
Number of trainees	1,613	1,716
Total costs	$1,788,348	$1,487,496
Cost per trainee	1,109	867

(4) P11 Automobile Mechanic - Distribution of Costs

Number of trainees	1963	$2,807
	1964	3,062
	1965	3,735
Average cost per trainee	1963	$1,208
	1964	1,326
	1965	1,117
Percent instructional services	1963	51
	1964	56
	1965	60
Percent fixed changes	1963	7
	1964	8
	1965	9
Percent maintenance and repair	1963	2
	1964	2
	1965	1
Percent equipment	1963	32
	1964	26
	1965	22
Percent other costs	1963	8
	1964	7
	1965	8
Percent local supervision	1963	8
	1964	8
	1965	10

P89 Rate of Employment of Persons Completing Course

Auto Mechanic

Number of completions in the labor force	1,450
Percent of completions employed	88.3

male	88.3	white	90.0
Female	50.0 (?)	nonwhite	78.5

(5) P62 Average Cost per Trainee

1963	$1,208
1964	1,326
1965	1,117
1966	1,114

NOTE: Occupational data grouped - auto mechanic included in "skilled occupations."

(6) P18 Chart V

Machine trades - 21% of enrollment
Auto mechanics and repairmen 30% of this

P55 Table 3 Distribution of Earnings - All Training
Cumulative Through January 1967

Rate	Pre	Post
$ .50 - $1.49	55%	33%
1.50 - 1.99	22	30
2.00 and over	22	32

P56 Approved Cost - Auto Mechanic

1967	$1,252
1966	1,114
1965	1,117
1964	1,326
1963	1,208

P95 National Contracts - Auto Mechanics

Capital Car Distributors, Inc., Lanham, Maryland
60 trainees

Import Motors, Chicago, Illinois
60 trainees

(7) P83 Table Cl Distribution of Enrollment FY 67 and 68

Institutional		
Machine trades	1967	21.3%
	1968	22.4
including Motor Vehicle Mechanics and repair	1967	6.2%
	1968	7.1

P84	On-the-Job		
	Machine trades	1967	27.7%
		1968	22.3
	including Motor Vehicle Mechanics and repair	1967	2.4%
		1968	3.0

NOTE: Occupational data grouped - auto mechanic included in "machine trades."

APPENDIX C: UNPUBLISHED ENROLLMENT STATISTICS [71]

]. Estimate of Number of Program Completions Employed

Data complied in the Office from FY 1968 State Annual Reports indicate the completions of various secondary and postsecondary instructional programs. Completions for adult programs are not recorded since these persons are already in the labor force. Follow-up data on completions is collected but is aggregated by the States in broad categories such as technical education and trades and industry.

For all trade and industrial programs the percent placement in the field trained or a related field, of those available for placement, is 74.1 percent with 69.2 percent and 88.0 percent for secondary and postsecondary respectively. Data indicates that 56.9 percent of the secondary program completions and 64.8 percent of postsecondary completions are available for placement with the remaining 43.1 percent and 35.2 percent respectively going into the Armed Services, continuing full-time study, or for other reasons not available. Since these percentages apply to the entire category of trades and industry, it can be assumed that similar figures would apply to automotive programs. Therefore, by instructional programs, the following numbers of 1968 completions may be expected to be employed full-time in the field trained or a related field.

	Program	Sec & Psec Completions	Est. Employed in Field Trained
17.0300	Automotive Industries	3,947	2,925
17.0301	Body and Fender	4,116	3,050
17.0302	Automotive Mechanics	26,570	19,688
17.0303	Specialization	542	402
17.0399	Other Automotive	1,347	998

2. Enrollment by Length of Class

Based on a limited survey of States to determine length of automotive programs, the following estimated enrollments were made for FY 1968:

Program Length	Secondary Programs Number	Postsecondary Programs Number
1 hour period	0	0
2 hour period	26,548 (26%)	7,225 (30%)
3 hour period	51,053 (50%)	4,816 (20%)
4 hour period or more	24,506 (24%)	12,041 (50%)
TOTAL	102,107	24,082

3. Expenditures Per Enrollment

Sufficient data on expenditures for vocational programs are not reported by the States to provide accurate unit-cost data. Only direct expenditures for instruction and ancillary services which are supportable under the State plan for vocational education are provided and not data for such objects as capital outlay, maintenance, and administrative overhead expenditures.

Data from State reports for fiscal year 1968 indicate a total expenditure for trade and industrial education of $268,407,000 which when allotted uniformly to the total enrollment of 1,628,542 gives a per capita expenditure of $164.81. There is, however, considerable variation in what constitutes an enrollment. Therefore, a more accurate figure may be derived by relating expenditures and enrollments by level of training. It may be assumed that automotive training is typical of the average program in trades and industry as to length of time, class size, and salary paid for instruction which constitute the major expenditures.

Dividing the instructional expenditures attributable to a given level by the enrollment at that level gives a per student expenditure as follows:

	Direct Annual
Expenditure per secondary student	$305.48
Expenditure per postsecondary student	436.91
Expenditure per adult enrollee	31.61

As indicated above, this expenditure is understated because of the State plan limitations. According to cost studies reviewed, such expenditures may generally be considered as 70 percent of the total costs. Expanding the figures by an additional 30 percent for school overhead costs such as capital outlay, administration, and building maintenance results in the following:

	Additional 30% Overhead	Two Year
Expenditure per secondary student	$397.12	$ 794.24
Expenditure per postsecondary student	567.98	1,135.96
Expenditure per adult enrollee	41.09	

These figures are intended only to provide a gross measurement. The two-year expenditure is given since the majority of trade and industrial programs require two years for completion and would therefore be the vocational expenditure for training a person for the occupation.

Another aspect of vocational training which must be considered is that this training is only a part of the person's total educational curriculum. Generally the vocational education component which is reflected in the figures above accounts for one half or a lesser portion of the student's total time in school.

ENROLLMENTS AND COMPLETIONS IN AUTOMOTIVE RELATED COURSES, FISCAL YEAR: 1968

	Automotive Industries (17.0300)	Body & Fender (17.0301)	Mechanics (17.0302)	Special-ization (17.0303)	Other Automotive (17.0399)
TOTAL	20,000	18,521	116,480	10,224	3,992
Secondary	16,251	9,716	61,821	1,004	2,814
Post-Secondary	452	3,682	17,490	151	279
Adult					
Preparatory	920	1,486	7,803	837	56
Supplemental	1,550	2,901	26,661	8,140	611
Special Needs	827	736	2,705	92	232
Completions					
Secondary	3,875	2,933	22,467	391	1,224
Post-Secondary	72	1,183	4,103	151	123

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